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# Teachers' Social Representations of Inclusion of Children with Autism Spectrum Disorder (ASD) in Regular Class

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## *Abstract*

This research study aims to explore the social representations that kindergarten and first elementary class teachers have regarding the inclusion of children with Autism Spectrum Disorder (ASD) in the regular classroom. The data collection tool was a questionnaire based on previous research. The results indicate that the teachers of the present study are willing to include students with Autism Spectrum Disorders in their regular class and try to address the related difficulties. The age of the educators and their educational level do not affect their views on the inclusion of children with autism into the regular class. However, their views are influenced by their years of experience, as well as by their previous experience of working with children with autism.

*Keywords:* Autism Spectrum Disorders, teachers, social representations, inclusion, regular class.

## 1. Introduction

### 1.1 *Definition of Autism Spectrum Disorders*

The term “Autism Spectrum Disorders” refer to a group of neurodevelopmental disorders that appear in early childhood and remain throughout their life due to developmental dysfunctions of the central nervous system. These are complex disorders that affect the way the children interact with the world and the surrounding environment. Individuals with severe disorders are characterized as low-functioning individuals, while at the other end of the spectrum, there are people with milder symptoms, who are characterized as high-functioning. Children with more severe disorders may be constantly improving and progressing, but they cannot usually be self-sufficient and need constant care and supervision. The concept of spectrum indicates the existence of graduations and the variety of clinical expression. Characteristics such as different

intelligence, varying degrees of severity of the disorder, and the degree of functionality of the individual are factors that are due to the heterogeneity of autistic spectrum and the wide variety of clinical expression. Even in the same person with autism, the picture may change depending on the age and cognitive ability of the individual (Francis, 2012).

According to DSM-IV (1994), Autism Spectrum Disorders include three disorders: autistic disorder – autism, Asperger's Syndrome and high-functioning autism.

In 2013, the revised version of DSM-IV, the DSM-V, was published, which differs in some areas from DSM-IV. Their overall diagnostic approach, however, is similar. Thus, according to DSM-V (2013), the diagnostic subcategories present in DSM-IV have been eliminated and Autism Spectrum Disorder (ASD) is considered as a diagnostic category characterized by a group of symptoms. There are now three subcategories that are differentiated based on the severity of symptoms: Level 3: "Need for Special Enhanced Support", Level 2: "Need for Enhanced Support", and Level 1: "Need to Support".

### *1.2 Definition of "children with special educational needs" and "inclusion of children with special educational needs"*

According to Greek law 3699/2008, children with special educational needs and disabilities are considered to be children who, for their whole life or a specific period of their school life, experience learning disabilities due to mental disability, sensory impairments regarding sight and hearing, motor disabilities, chronic irreversible health problems, speech disorders, special learning difficulties (dyslexia, dyspraxia, dyscalculia, reading disabilities), attention deficit disorder with or without hyperactivity, in developmental disorders, mental and neuropsychiatric disorders and multiple disabilities. In addition, children with special educational needs are also children experiencing cognitive, emotional and social difficulties as well as offending behavior, which may be due to abuse, domestic violence, parental neglect and abandonment. It is worth noting that the same category includes gifted children while children with low school performance attributed to external factors such as linguistic or cultural specificities are not included in the category of children with special educational needs.

The terms "abnormal, inappropriate, divergent, problematic" have been previously used to describe these children, which have now been replaced by "children with special educational needs" because they are less emotionally charged, do not promote isolation and labeling of these children and encourage their social and school inclusion (Polychronopoulou, 2008).

According to Kaiseroglou (2010), special educational needs exist when the children present difficulties, which impact their learning that require differentiation or specialization or modification of the curriculum and learning conditions in order to be appropriate and effective the education of the child.

Heward (2011) reports that children with special educational needs are those whose physical traits and learning skills vary above or below average, and thus there is a need for a personalized program, as well as related services to benefit these children. Specifically, it is argued that children with learning and behavioral problems, children with physical disabilities and sensory disorders, and also children whose mental level is so high or that they have a talent which is considered to be charismatic, need modifications in teaching in order to be able to make full use of their capabilities.

The term "inclusion" refers to the placement of a student in a regular classroom with the aim of being an organic, integral, and active member. As far as the definition of inclusion in pedagogical science is concerned, it includes pedagogical practices aimed at respecting and

recognizing the right to diversity. It also includes providing equal educational opportunities for all children. Therefore, “inclusion” refers to the placement of children with special educational needs into the regular class and their acceptance by the other students. During the process of inclusion, children are trained by a special educator. They are not always participating, to the same extent, in the same activities as typical children. However, they interact with the rest of the children, socialize and coexist in the same class (Soulis, 2003).

### *1.3 The inclusion of children with Autism Spectrum Disorders in the regular classroom*

As stated above, the basic principle of the full inclusion of children with special educational needs, and therefore children with autism, in the regular school is that all children should experience the same experiences and learn in environments that allow them to acquire new knowledge and to develop, as far as possible, their abilities, both cognitive and socio-emotional (Kourkoutas, 2011; Taffa, 1998). This right has not always been recognized equally for all children. Therefore, in 2000, the relevant legislation in our country has acknowledged that children with autism have the right to participate in the educational process, accepting thus their right to diversity (Syriopoulou-Delli, 2011). Consequently, the idea of an inclusive school for all children is gradually being promoted, with the ultimate goal of full inclusion of children with autism into the regular classroom.

It is therefore observed that students with autism tend to be increasingly placed in regular schools and classes, with the aim of social inclusion. Appropriate efforts and conditions can lead to their acceptance by their teachers and peers as well as to the gradual improvement of their cognitive and emotional abilities (Heward, 2011). The learning process, however, should take into account the potential of each student.

Regarding the teaching of children with autism in the regular class, emphasis should be placed on the interaction of children and the progressive development of their sensory, motor and cognitive abilities. The main axes of the educational process in a school, which seeks the full inclusion of children with ASD, should be the cooperation of children as well as a climate of collectivity and mutual acceptance. Furthermore, the goal of inclusion is to enable children with autism to benefit from this process and other contexts. Gradually, the engagement of children with autism in classroom activities is feasible, as well as the completion of the tasks assigned to them and the achievement of communication with teachers and their classmates. It is also important that the curriculum and the proposed activities be adapted and integrated into the needs and abilities of children with autism (Zoniu-Sideris, 2004; Taffa, 1998). In addition, a teacher should take into account the difficulties and needs of these children, ensure that the activities of the children are interesting and attract the interest of all students, so that they are intrinsically motivated to participate. Moreover, it is essential to provide children with autism the information they need in a simple way, in order to understand their environment (Vogindrukas & Sherratt, 2005).

In this context, teachers of a regular class in which they wish to include children with autism can incorporate into their teaching imitation, which is important for learning and creating relationships with other people. They can also try to teach children with autism to keep the flow and the duration of day-to-day activities in class as well as to give children the chance to choose these activities. These activities, in fact, can be tailored to engage children with capabilities and varying abilities, through the use of preferred materials, so that children with autism can also use their abilities. They are also advised to have relatively high expectations from these children, considering that they can achieve the goals set in order to encourage them to try without, of course, being disappointed if the achievement of the above objectives is not achieved shortly. Finally, it is important that the skills the teacher will set as goals to be useful in life and everyday life of each

child. In addition, teachers should use ordinary and everyday materials to teach children with autism in order to become familiar with their use (Heward, 2011).

Zoniou-Sideri (2004) argues that in the process of fully including children with autism into a regular class with formally developing children, there appear to be progressively small and important improvements in both the disorder itself and the performance of children. The process of learning seems to improve, and there is a gradual improvement in children's abilities, sometimes making it possible to promote them to the next class. It is expected that depending on the degree of functionality of each child and on the basis of his/her intelligence, it is sometimes necessary to take longer periods of time for children with autism to improve their school performance and their socialization skills. What is also important is the patience of the teachers and classmates, the creation of favorable conditions and the support they provide to children with ASD, thus facilitating the inclusion process. Teachers' efforts are essential to children's adaptation to school environment and to their mental health promotion (Nikolaou & Markogiannakis, 2017a). Therefore, the full inclusion of children with autism into the regular class is not simple and easy, especially if the necessary conditions are not met and if there is not the necessary effort and will on the part of the teachers and the rest of the students. However, the inclusion of children with autism in regular schools and their co-education with formally developing children in the same class is feasible and can lead to positive and encouraging results.

According to Gena (2002), the full inclusion of children with autism into a regular class, requires that their behavior be analyzed in advance so that the necessary objectives of the teaching are gradually set. In addition, she maintains that the areas where children with autism are experiencing difficulties are those of participation, understanding of speech, inability to communicate and socialization. She also posits that children with autism have noticeable differences in their verbal communication in relation to their peers who are typically developing, as well as in understanding and speaking. However, she argues that with a systematic effort, it is likely that a significant improvement will be observed in those areas that until recently have lagged to a great extent.

#### *1.4 Previous research on the social representations of teachers about the inclusion of children with ASD into the regular class*

The theory of social representations was first introduced in 1961 by Moscovici and comes from Durkheim's collective representations. It is essentially a complex psychological process, which includes all the individual representations, individuals and groups, so that there is a transition from the individual to the collective level, and vice versa. Each person, according to Moscovici, shapes interactive relationships with the environment around him. As a result of it, the stimuli and the reactions shaped by the environment are incorporated into a context, the social representation. Social representations consist of two aspects, the passive, in which the image of an object is in the brain, and the energetic, where the stimuli and reactions interact and create frameworks of values, structures and concepts. In the case of the phenomenon of inclusion, social representations concern the practical thinking that is related to the understanding of the phenomenon in which the contents are organized, emerge and circulate through the continuous interactions (Michaelides, 2009).

Therefore, the study of social representations of teachers for the inclusion of children with Autism Spectrum Disorder into the regular school is particularly interesting. Initially, social representation is defined by social thinking, knowledge and views, that a group of people has on a subject, in this case, about the ASD and the phenomenon of including these children in regular schools. The exploration of social representations aims to conceive the knowledge and perceptions of teachers about the inclusion of children with ASD in the general class and the acceptance of the "different". Social representations for the inclusion of children with ASD may vary according to

the teachers' knowledge, views and personality, the teaching method used, their behavior during the teaching process, the forms of communication they develop with the pupils, but also the forms of communication developed by the pupils themselves (Michaelides, 2009).

Humphrey & Symes (2013) found that the perceptions of secondary school teachers about the inclusion of children with autism in the regular class have changed over the years and are more positive than before. However, few are those who feel they do not have the necessary knowledge and skills to teach children with autism. For this reason they are inclined to acquire more knowledge through training programs, thus indicating their willingness for new knowledge and specialization.

In addition, as shown by the Kimberly's study results (2008), more training results in positive attitudes towards the inclusion of children with autism in regular classes, while the increase in years of experience seems to have a negative impact on the views of primary school teachers' inclusion training.

This was confirmed and complemented by Cassady's (2011) research, in which participating primary school teachers showed particular confidence in individual education plans and agreed to tailor the courses according to students' needs and to work with their highly trained colleagues, to design appropriate programs and create the appropriate teaching environment for children with autism within a regular classroom. A prerequisite is still the proper preparation and acquisition of academic knowledge or the implementation and monitoring of compulsory training programs. Thus, teachers would have a more positive attitude towards children with autism and would be more able to manage and include them in a classroom with formally developing children.

According to Barned (2009), the knowledge of primary education teachers on autism is not shaped and not so much influenced by their studies and the limited knowledge they have gained in these studies, nor by their experience or their subject. Their perceptions about the inclusion of children with autism within a regular classroom are positive, except for cases where the pupil has severe autism and can become dangerous to himself or his classmates. They argue that if there is a special class teacher, the process of fully including the child with autism would be beneficial for both the child himself and the class as a whole.

The Gregor & Campbell (2001) study, on the other hand, indicated that teachers who support the inclusion of students with autism into regular schools are considerably fewer than those who oppose to it. Nevertheless, those with similar experience also held more positive views. Quite a few felt that this might negatively affect typical developing students, but they did not deny to receive any training. Different conclusions are led by the Park & Chitiyo (2010) research study, according to which teachers have a positive view of the implementation of this inclusion.

Another recent study (Rodríguez, Saldaña & Moreno, 2012) found that primary school teachers believe that the inclusion of children with autism in regular education is a challenge for those involved, who need some support. If this support is provided, they are likely to have a positive attitude towards inclusion.

In conclusion, many research studies conducted in different countries of the world, indicate that teachers' views on the full inclusion of children with autism in their regular classroom and their co-education with formally developing children vary. In recent years, teachers' views tend to be more positive, but they do not think they have the proper knowledge, experience and support for successful inclusion.

## 2. Research methodology

### 2.1 *Participants*

The participants of this research are teachers, 20 primary school teachers and 38 kindergarten teachers, in regular elementary schools and kindergartens respectively, who completed the survey questionnaire in Rhodes and Athens, Greece. More specifically, 90% of teachers were women, while only 10% were men. 82 % of them were aged 30-50 years old. 68% of the sample were kindergarten teachers and the remaining 32% were primary school teachers. As far as the educational level of the teachers is concerned, 59% were exclusively university graduates. Regarding their years of experience, about 33% had a experience of 11 to 15 years and 21% had a experience of 26 to 30 years. It is also worth mentioning that only 2 people, 3%, had a member of their family diagnosed with autism spectrum disorders, as opposed to the rest (97%). 90% of the sample has not worked in a special class of a special school and 79% has not worked in a classroom of foster teaching. Finally, with regard to the identity of the participating teachers, 59% had teaching experience with a child with autism, while the remaining 41% had no relevant experience.

### 2.2 *Data collection tool*

Quantitative method was used to implement this research. The data collection tool was a questionnaire, which is one of the basic techniques of the quantitative method. The questionnaire is a widespread and easy-to-use tool for collecting information and can be supplemented without the presence of the researcher in the field. It is a technique of the quantitative method, which allows the use of quantitative analyses of data collected from a large number of samples, as well as the comparison between the respondents and the answers they have given to one or more questions (Cohen, Manion & Morrison, 2008; Zafiroopoulos, 2005 ). The questionnaire used in this research was based on Michailides' research study (2009). It is a structured questionnaire, which was slightly modified to meet the purpose of the research and was administered to kindergarten teachers and primary school teachers in Athens and Rhodes. It consists of 9 closed questions, which refer to the identity of the participants, followed by 26 questions regarding the inclusion of children with special educational needs in regular classes, especially children with autism, a closed question about the type of education which they consider to be more appropriate for a child with autism and an open question for comments or remarks that the respondents may desire to make.

## 3. Results

The data collected by the answers to the questionnaires are quantitative data and therefore the SPSS statistical software was used for their analysis. In particular, the data were analyzed by descriptive statistics and then the results were compared and correlated.

Initially, the degree of agreement of teachers on the inclusion of children with autism was examined in relation to their respective views on children with intellectual disabilities and sensory disabilities. The degree of agreement was calculated by adding the scoring to the corresponding questions, while the negative questions were reversed.

According to the results, it seems that teachers agree that children with autism as well as children with sensory disabilities ( $t = 0.233$ ,  $p = 0.817$ , see Table 1) should be included in the regular class. However, the degree of agreement for children with intellectual disabilities is statistically significantly lower than the level of agreement for children with autism ( $t = 3.540$ ,  $p = 0.001$ , see Table 1).

Table 1. Correlation of teachers' views on the inclusion of children with autism, sensory disabilities or cognitive disabilities in the regular class (N=58)

<b>Disorder</b>	N	Average Degree of agreement (%)
Autism	58	62.7
Sensory disabilities	58	62.2
Mental Disability	58	56.8

Regarding what type of class and education they consider to be more appropriate and effective, most teachers seem to consider as the most appropriate context for children with autism the regular class with the parallel provision of some kind of assistance (average = 67.8,  $F = 6.665$ ,  $p = 0.001$ , see Table 2).

Table 2. Teachers' views on the most appropriate class and education for children with ASD

<b>Most appropriate type of class and education</b>	N	Average Degree of agreement (%)
Regular class with some kind of help	34	67.8
Special School	12	50.3
Regular class with some kind of help + Special School	11	61.6
I do not know	1	60

Teachers' views on the inclusion of children with autism in the regular class did not differ according to their age ( $F = 1.386$ ,  $p = 0.257$ , see Table 3). The same applies to their educational level, as there were differences, but not statistically significant ( $F = 1.047$ ,  $p = 0.406$ , see Table 4).

Table 3. Correlation of teachers' age with their views on the inclusion of children with autism in the regular class

<b>Teachers' age</b>	N	Average Degree of agreement (%)
22 – 30 years old	6	71.7
31-40 years old	14	65.1
41-50 years old	34	60.7
>51 years old	4	60.3

Table 4. Correlation of the educational level of teachers and their views on the inclusion of children with autism in the regular class

<b>Educational level of teachers</b>	N	Average Degree of agreement (%)
Graduate University	34	63.1
Teaching School of Regular Education	12	60
Teaching School of Special Education	4	60.3
Postgraduate Studies in Special Education	2	84.6
Seminars in Special Education	3	60
Teaching School of Regular Education + Seminars in Special Education	2	62.6
Teaching School of Regular Education + Postgraduate Studies in Special Education + Seminars in Special Education	1	66.6

The answers of the teachers of the sample indicate that their views are influenced by their years of experience, since teachers with 1-5 years and 6-10 years of experience hold more positive views, as statistically significant differences were found ( $F = 3.588$ ,  $p = 0.007$ , see Table 5).

Table 5. Correlation of teachers’ years of experience and their views on the inclusion of children with autism in the regular class

<b>Teachers’ years of experience</b>	N	Average Degree of agreement (%)
1-5 years	6	71.7
6-10 years	6	78.2
11-15 years	20	58.6
16-20 years	6	65.5
21-25 years	9	57.4
26-30 years	11	60.4

Finally, with regard to the past experience of teachers who participated in this research with children with autism and whether this variable affects their views on the inclusion of these children in the regular class, there were no significant statistical differences but there was a tendency the teachers with the most experience with children with autism to be more positive about the inclusion of these children in the classroom ( $F = 3.182$ ,  $p = 0.080$ , see Table 6).

Table 6. Correlation of the past experience of teachers with children with ASD and their views on the inclusion of children with autism in the regular class

<b>Past experience of teachers with children with ASD</b>	N	Average Degree of agreement (%)
Answered “Yes”	35	65.4
Answered “No”	23	59.1

#### 4. Discussion

The aim of the present study was to study the social representations, perceptions and attitudes of kindergarten teachers and primary school teachers about the inclusion of children with ASD in the regular class. Primary school teachers and kindergarten teachers agree on the inclusion of children with ASD in the regular class, as well as on the inclusion of children with sensory disabilities. However, this is not the case with children with ASD and children with intellectual disabilities, as it seems that in this case it is more likely to accept and include in their class a child with autism than a child with a mental disability.

Regarding what type of education teachers consider as the most suitable for attending children with autism, it is noteworthy that according to their answers they consider as the most appropriate the regular classroom, while providing to them some kind of support by a counselor or a special educator (parallel support or inclusion class). The placement of these children in a special school follows and finally, there are also some participants who support one of the above forms of education, depending on the severity of autism.

It is also noted that teachers’ views on the inclusion of children with autism in the regular class are not affected by their age. The same applies to their educational level, since it was noticed that even on the basis of this criterion there were no significant differences in their views.

However, teachers’ years of experience affect their views, as teachers with 1-10 years of experience have more positive attitudes towards the inclusion of children with autism than

those with more years of experience. This may be due to the fact that teachers with fewer years of experience will probably be younger. As a result, it is likely that younger teachers have received different initial academic education from older teachers and have attended more special education courses or some training programs.

The correlation of the previous experience of teachers with children with autism with their views on the inclusion of these children in the regular class, reveals that there is a tendency for teachers who have more experience with children with autism in their class to be more positive towards the inclusion of these children in a regular class.

As mentioned above, various studies have been carried out to study the views of teachers of different educational levels on the inclusion of children with ASD in regular classes. Comparing, therefore, previous research to the present study, some similarities and differences are observed. The present study indicates that teachers are in favor of including children with autism into the regular class, and also consider it important to work with their specially trained colleagues in order to help them and guide them. This finding agrees with previous research (Cassady, 2011; Park & Chitiyo, 2010; Barned, 2009). The study of Barned (2009) has several common findings, such as the finding that teachers' views are not influenced by their studies and educational levels. In addition, Humphrey & Symes (2013) as well as Kimberly (2008) report that the perceptions of secondary school teachers about the inclusion of children with autism in the regular class have changed over the years and are more positive than before. This is confirmed by the present research as their views are influenced by their years of experience, since teachers with fewer years of experience are more positive.

The present study contrary to previous research shows that teachers' experience plays a role in shaping their attitudes towards the inclusion of children with autism, Barned (2009) concludes that teachers are not influenced in formulating their views by their years of experience. Additionally, Gregor & Campbell (2001) argued that teachers who favor the inclusion of students with autism in primary school are considerably fewer than those who oppose it, as opposed to the present research, where most teachers seemed to be positive for the inclusion of children with autism. The above differences are likely to be due to intercultural differences, as the countries in which each survey is conducted differ, as well as the way of life, upbringing and education of the population differs. Teachers in other countries may have a different perception and way of addressing these issues or they have a different educational system which provides for different structures and programs for the education of children with autism. Finally, it is worth mentioning that the present research differs from the aforementioned studies, as this study also examines the views of active kindergarten teachers and not just primary or secondary school teachers. The findings of the present study cannot be generalized to the general population due to the small sample size. Further research could clarify the factors that contribute to the successful inclusion of children with autism in school context.

## 5. Conclusions

In conclusion, according to the findings of this study, it is clear that the age of the educators and their educational level do not play a special role in shaping their views on the inclusion of children with autism into the regular class. However, their views are influenced by their years of experience, as well as by their experience with children with autism. It is, therefore, observed that teachers are willing, under certain conditions, to include in a regular class, the children with Autism Spectrum Disorder, in which they teach. The inclusion of a child in a regular class involves various difficulties that teachers, students with ASD and the rest members of the class may face. These difficulties constitute a challenge that teachers have to cope with so that the inclusion to become as effective as possible, both for the student with ASD and the whole class.

The theory behind the implementation of this research is that of the inclusion philosophy. Pedagogical science is now based on the principles of inclusion. These are educational practices aimed at respecting and recognizing the right to diversity and equal education opportunities for all children without categorization and discrimination (Soulis, 2003). These pedagogical principles, moreover, concern the placement of children with special educational needs in the regular class and their acceptance by the whole educational community, teachers and other pupils. The basic principle of inclusion is therefore to remove all kinds of prejudices and to try to ensure that all children have the same learning opportunities in environments that enable them to acquire new knowledge and develop their cognitive and socio-emotional abilities, to the extent that is feasible (Kourkoutas, 2011; Taffa, 1998). Teachers perceptions affect their responses (Nikolaou & Markogiannakis, 2017b), and therefore their positive attitudes about the inclusion of children with autism is a key factor in their adaptation to their school environment.

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## Special Needs Teachers' Perceptions on the Psychometric Test

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### *Abstract*

In this survey a presentation of the difficulties of students with mild intellectual disabilities is performed. Intellectual disability is a neurodevelopment diagnosis and it refers to children who have developmental, adaptive behavioural and cognitive difficulties compared to their peers. Intellectual disabilities are categorized by their severity into: mild, moderate, severe, or profound. The purpose of this research is to construct a psychometric instrument for detecting intellectual disabilities in high school and specifically high school students aged 13-17. In order to find out if the specific psychometric test is appropriate to detect Intellectual disability, questionnaires have been given to special needs teachers. The research findings illustrate that the specific psychometric test is appropriate in order to detect intellectual disability.

*Keywords:* intellectual disability, psychometric test, detection, teachers' perception.

### 1. Introduction

Intellectual disability is referred in the international literature as intellectual subnormality, developmental disabilities, feble-mindedness, idiocy. It is considered as one of the most serious disadvantages in the spectrum of developmental disorders. Intellectual disabilities are categorized by their severity into: mild, moderate, severe, or profound. Intellectual disability is defined in various ways, which include learning, social and biological characteristics. Although it was first appeared in ancient times, however, until now, it is almost a modern unsolved pedagogical problem.

The primary objective of the design of the psychometric tool is, on the one hand, to build a simple, easy-to-use, fast and pleasant tool that can be used by teachers and, on the other hand, to deliver a simple and easy evaluation of the probability of existence intellectual developmental disorder.

Secondly, a profile of strengths and weaknesses should be created, which can be used as the basis for a possible future improvement.

In addition, this research was also conducted in order to examine the views of the teachers whether the particular psychometric tool is capable of diagnosing a potential intellectual disability.

- Detection of intellectual disability.
- Teachers’ perception on memory detection.
- Teachers’ perception on intellectual detection.
- Teachers’ perception on mathematical characteristic detection.
- Teachers’ perception whether the specific psychometric tool can help in diagnosing intellectual disabilities.

Being supported both by theory and research, the following research questions are formulated:

- Is it possible to diagnose intellectual disability by using the specific psychometric tool?
- Can the specific psychometric tool diagnose difficulties in students’ linguistic development?
- Can the specific psychometric tool diagnose difficulties in students’ mathematical development?

## 2. Methodology

### 2.1.1 *Research access*

In this research, a deductive approach was used. The survey used the literature to move from general theories and ideas, to more specific results by using data. According to Saunders et al. (2003) deduction emphasizes is: a structured approach, quantitative collectiveness, moving from the general theory to more specific data, scientific approaches, to certify the validity of data with the appropriate controls, and the independence of the researcher concerning what is being researched and necessity to select samples.

### 2.1.2 *Research design*

A survey strategy was used for the specific research. According to Saunders et al. (2003) a survey strategy is appropriate for the deductive approach. Surveys help the researcher to collect a large amount of data from a substantial teaching population regarding their educational beliefs. They can be obtained through questionnaires and the data is standardised allowing the researcher to compare them easily. Moreover, using a survey strategy gives more control over the research process. Denscombe (2003) state that, questionnaires are an appropriate data collection method that belongs to the survey research strategy.

### 2.1.3 *The collection of primary data using questionnaires*

In order to collect the research data and to understand the relevance of the research process on the research issue, questionnaires were used. According to Rugg and Marian (2007), the questionnaire is a tool for communication. Using questionnaire, does not change people’s attitudes or provide them with information (Rose & Grosvenor, 2001). The important point in this research is that each teacher answers particular questionnaire with possible answers “Agree, Disagree and I do not know”. All of them are special need teachers in secondary mainstream

schools. The last choice, "I do not know", was included in order to minimise the possibility of random selection. Some of the questions refer to the teaching methods that teachers use during the lesson so as to present the symptoms of intellectual disability. This allows for consistency and precision in terms of the wording of the questions, and makes the processing of the answers easier (Denscombe, 2003). However, Silverman (1997) has pointed out that the questionnaire is a tool of communication. In the questionnaire, there is a risk for participants to use the help of other people, but, on the other hand they feel more comfortable and free with the questionnaire than to express their thoughts in one-to-one interviewing (Frankfort-Nachmias & Nachmias, 1992).

For a valid diagnosis concerning if the specific psychometric tool can detect intellectual disability, it was necessary to gather and assess information from all general areas of the teachers' practices. For this reason, the questionnaire was adjusted according to Greek reality. Closed questions were sent via internet with the help of Google drive, in order to save time. Furthermore, the Likert rating scale was used in order to determine how teachers agree or disagree with a series of statements, on a three-point rating scale. The main advantage is that the structure imposed on the teachers' answers provides the researcher with information which is of uniform length and in a form that lends itself nicely to be quantified (Hopkins, 2002).

Furthermore, special maintenance was given to the design of the questionnaire. The design of the questionnaire was formulated in such a way that it tested the theories on intellectual disability through statistical analysis and comparisons. Moreover, the questionnaire is highly functional, easy to fill in for the teachers and the sequence of the questions are understandable for the respondent. In addition, a covering letter was included so as to explain the purpose of this research and all these factors, contributed to higher response rates, validity and reliability.

#### *2.1.4 The collection of secondary data*

Secondary data is data that have been already collected by someone else (Denscombe, 2003). There are three main types of secondary data: documentary, multiple sources and survey; such as: reports, books, and academics' surveys. Secondary data help researchers to save money and time. Also, secondary data can be very effective in triangulating primary data that has been collected through questionnaires.

#### *2.1.5 Selecting samples*

Sample techniques enable a reduction in the amount of data needed to be collected, by considering a specific subgroup rather than a large amount of populations. This enables the researcher to save money and time (Rugg & Marian, 2007).

There are two kinds of sampling techniques. The first is known as probability sampling and the second as non-probability sampling. Probability sampling according to Denscombe (2003) is associated with a research method. Furthermore, it is based on the idea that the people or events that are selected as the sample are chosen because the researcher has some belief of the probability that these will be a representative cross-section of people or events in the whole population being studied.

#### *2.1.6 Response rate*

According to Denscombe (2003), the aim of a good research project is to have minimum non-responses and to have highest response rate possible. In a survey research, response rate refers to the total number of people who answered, divided by the total number in

the sample (Rugg & Marian, 2007). According to Healey (1991), for questionnaire surveys, a response rate of about 50 percent is the norm.

### *2.1.7 Sampling technique*

A purposive sampling technique had to be implemented to collect data via questionnaires. The advantage of using purposive sampling is that it allows the researcher to select the sample that might answer the research questions and that is likely to produce the most valuable data (Denscombe, 2003). Purposive sampling was selected with a specific purpose in our mind, teachers in special schools. The particular sample was chosen because it was relevant to the topic of the investigation. However, according to Silverman (1997), samples cannot be considered to be statistically representative of the whole population. Based on Healey (1991), who suggests that a usual response rate is about 50 percent, 160 questionnaires were sent via Google drive to teachers, in order to ensure a minimum response rate of 70 questionnaires as the Economist (1997) suggested. Finally, for the validity of the research the participants were homogeneous, for instance all highly experienced teachers, as the sample selection was based on teachers’ educational level and also all of them are working in special schools.

Last but not least, the selection of the teachers was made for the following reasons: those teachers are in the correct position to fill in the questionnaires because they have experience and are specialized in special education.

## *2.2 Data results*

### *2.2.1 Analyzing quantitative data*

In order for the data to be analysed quantitative analysis was used because it uses numbers and can present findings in the form of graphs and tables. “Coding the data, in essence, entails the attribution of a group of data, with the express aim of allowing data to be analysed in quantitative terms and save time” (Denscombe, 2003). Quantitative data according to Denscombe (2003) are the following: (1) using diagrams, graphs, tables; (2) represented by using numbers.

Data in this survey were divided into eight categories, so as to be more understandable. These eight categories define out the teachers’ Demographic Questions knowledge, Speed-processing information, psychological characteristics-spiritual fatigue-social characteristics, concentration-attention, memory, linguistic-cognitive characteristics and mathematical characteristics. The finally category will point out teachers’ general perception concerning the specific psychometric tool.

By comparing variables relationships and differences are examined. Firstly, by using tables the data is presented. Secondly, by using bar charts, the highest and the lowest values are shown. Thirdly, the pie charts data are presented as segments. Finally, data are entered in computer analysis by using the Excel Microsoft software.

### *2.2.2 Findings*

Research findings outline the key findings from a study and illustrate the point where the reader is introduced to the data (Denscombe, 2003).

### 3. Results

#### 3.1 Demographic questions

The first five questions from the questionnaire examine the Demographic Questions of the participants. They are presented the Demographics of 70 participants. The aim of the research is the participation of at least 100 teachers. Demographics include gender, age, educational level, the school unit at which they are currently serving, and years of service. All of them are teachers who work with special needs students. These questions are presented in Figure 3.1 and 3.5.

So far, 70 special needs teachers attend the research, 27 of them were men (40%) and 43 of them were women (60%). Of these, most were aged 35-44 (53%). The majority of the participants (46%) work in Gymnasium Middle School – Inclusion Classroom. Most of them have a Master’s degree in Special Education or School Psychology (74%), while few of them (11%) have a PhD. Finally, 12 teachers stated that they have up to 4 years (13%) of service, 48 of them work from 5-10 years (69%), 9 of them work from 10-15 (17%), while only one of them works more than 15 years (1%) and none of them has 21 or more years of service (0%).

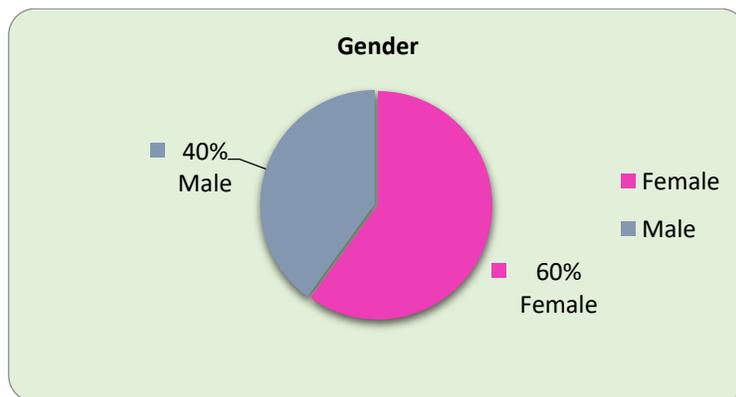


Figure 3.1. Gender of the participants

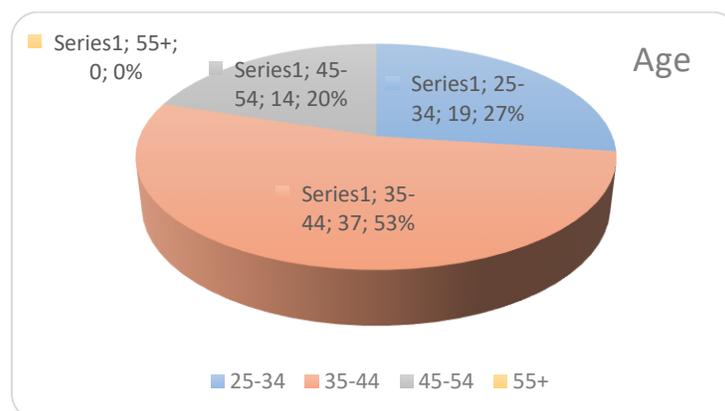


Figure 3.2. Age of the participants

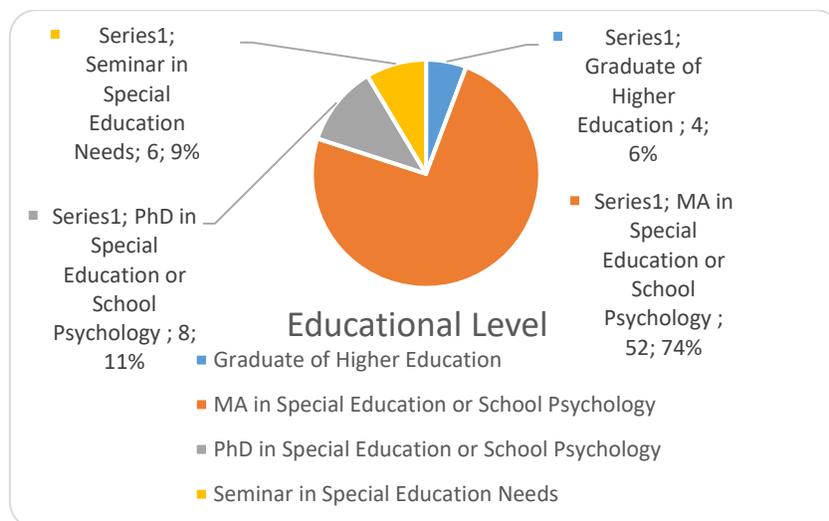


Figure 3.3. Educational level of the participants

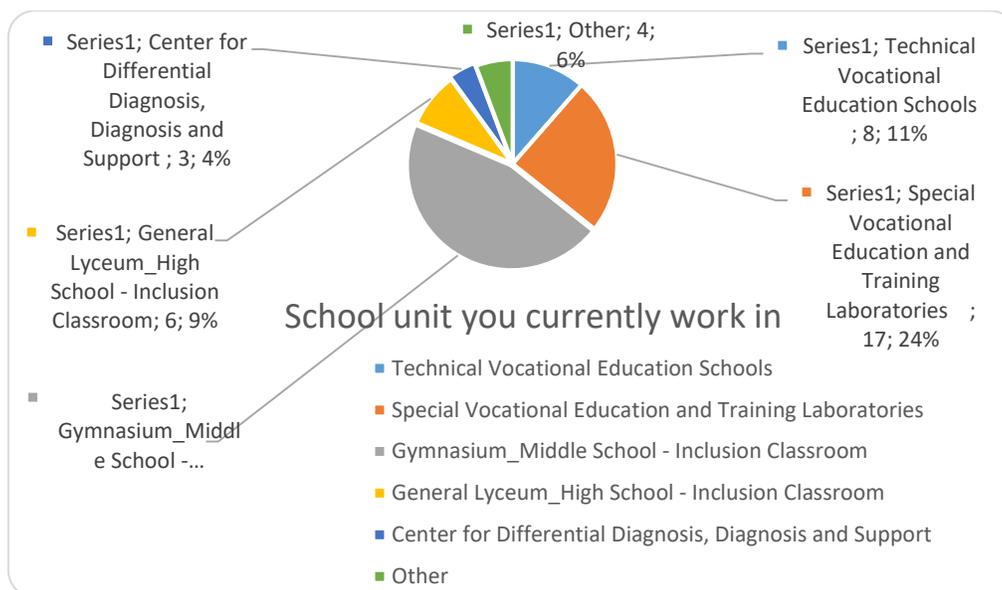


Figure 3.4. School unit the participants currently work in

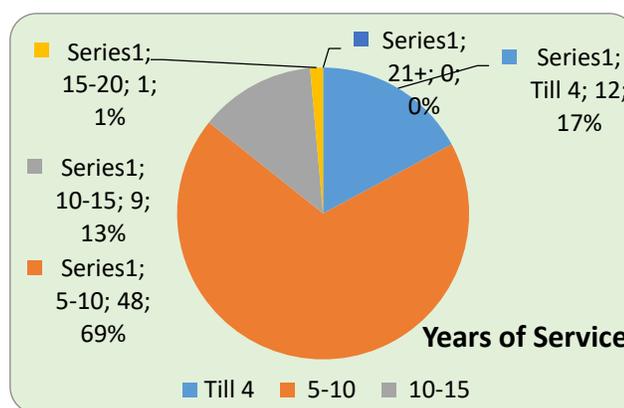


Figure 3.5. Years of service

### 3.2 Speed-Processing Information

The sixth and the seventh questions from the questionnaire examined the teachers' opinion concerning the Speed-Processing Information from the psychometric test which had been given to them. These questions are presented in figures 3.6 and 3.7. It is characterized that students with intellectual disabilities need more time coding compared to student without disabilities. According to the literature, Panteliadou (2000), suggests that students with intellectual disability are characterized by a slowdown in the speed of processing information, mainly a quantitative and not a qualitative difference, in relation to the "typical" children. On the one hand, 62 per cent of the teachers agree that the specific test is appropriate in order to detect if a child with intellectual disabilities has a slow rate in processing and in organization, while another 34 per cent disagree with that statement. On the other hand, only 4 per cent of them answered "I do not know".

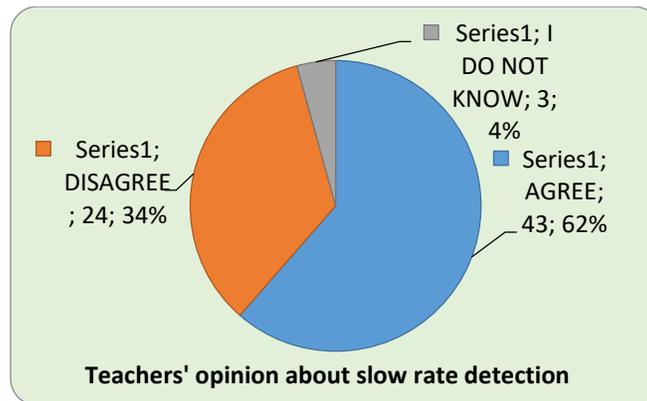


Figure 3.6. Teachers' perception on slow rate detection

Similarly, Figure 3.7, presents the teachers' opinion concerning time detection. 57% of them agree that the specific test can detect if the child with intellectual disabilities needs more time to decode (e.g. handwriting coordination) of known things, in relation to a child of the same age without intellectual disabilities. 40% of the participants disagree with that statement. Finally only 3% of them answered "I do not know". According to the literature, Hunt (1977), argues that children with mild intellectual disabilities need more time for processing and decoding of things which they know (Hunt, 1977) compared to their peers. Furthermore, Merrill (1990) pointed out that students with mental disability require more time than their schoolmates to automatically recall information, and therefore, they have more difficulties handling larger amounts of cognitive information at once.

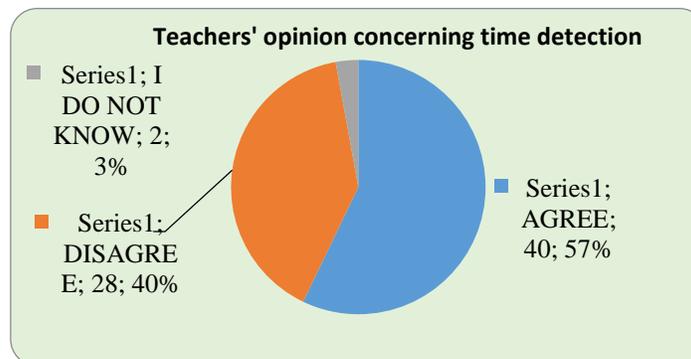


Figure 3.7. Teachers' perception on time detection

### 3.3 Psychological characteristics, spiritual fatigue and social characteristics

Students with intellectual disability face social and psychological difficulties. Panteliadou (2000), reported that a student with intellectual disability is characterized by a mental fatigue, much higher than the “typical” children, and easier regression in earlier stages of cognitive and psycho-emotional development. By examining teachers’ opinion regarding the mental fatigue detection; it is too significant to be told the strong correlation between the answers which has been found. A total of 47% of the teachers believe that the specific psychometric tool can detect if a student presents mental fatigue. Moreover, about 44% believe that this test cannot detect mental fatigue. Finally, only six teachers answered “I do not know” specifically, a percentage of 9% (Figure 3.8).

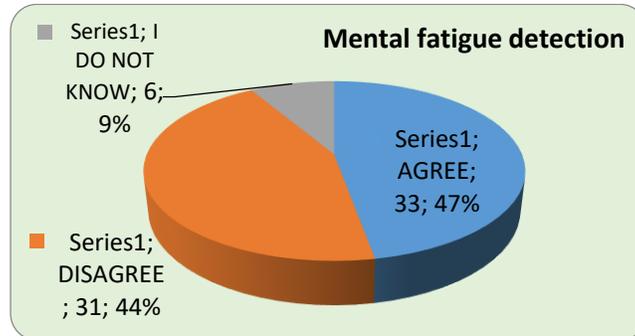


Figure 3.8. Teachers’ perception on mental fatigue detection

Students with intellectual disability have difficulties in thinking before acting. To begin with, the majority of teachers, about 79% agree that through this psychometric tool it can be detected if children with intellectual disabilities can think before they act. Specifically, 79% of the teachers answered agree, 21% of them answered disagree while none of them answered I do not know (Figure 3.9). These results correspond with Kroustalakis (1990), who state that students with intellectual disability have not the ability to control their behavior and they act before thinking. Additionally, they are characterized by anxiety, impulsiveness and low self-esteem.

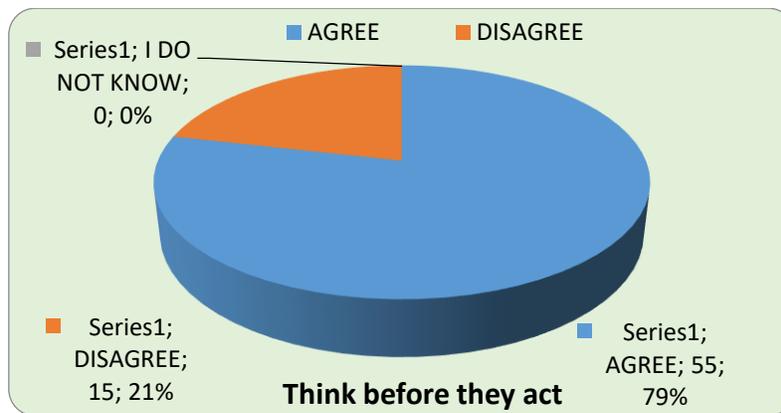


Figure 3.9. Teachers’ perceptions whether students with intellectual disability think before they act

Moreover, 63% state that the specific psychometric tool detects self-awareness and low self-esteem posed by students with intellectual disabilities, whilst 37% of the teachers’ disagree with the specific statement (Figure 3.10). This comes in accordance with Paraskevopoulos (1980) who argues that children with intellectual disability face inability to take action or follow commands with a consistent and independent manner. The feeling of inferiority and low self-

esteem stems from the disappointment which is obtained at school where the demands and expectations are usually higher from their potential. Moreover, they have low or no expectations of success due to their cognitive difficulties. Finally, they do not have a coherent personality, and they do not have the skills of self-awareness, which means that they have low self-esteem.

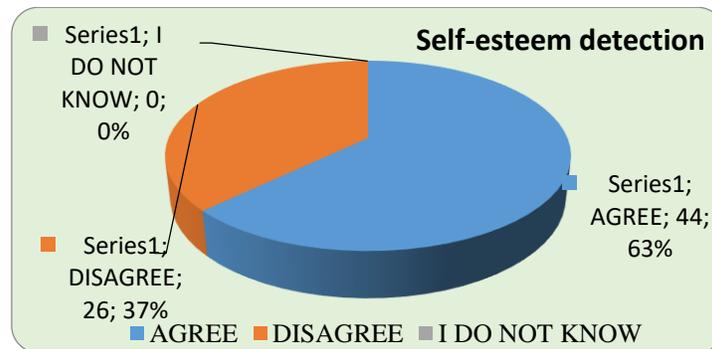


Figure 3.10. Teachers' perception on self-awareness and low self-esteem detection

### 3.4 Concentration-attention

Another feature which was examined in the research was teachers' opinion about detection of concentration-attention (Figure 3.11). According to the literature, Polychronopoulou (2001), an important characteristic of those students is the maintenance of their attention to an activity. Moreover, she argues that they have poor visual-motor coordination.

Furthermore, according to Westling (1986), students with intellectual disabilities face difficulties in the attention of appropriate dimensions such as shape, size, position, color and weight of a particular object. In addition, these children find it difficult to notice the correct dimensions of the objects, which will provide them with the necessary information for a successful distinction between them. Furthermore, Barbas (2008), argues that children with mild mental disability face problems in gathering information, in reading and in other cognitive functions.

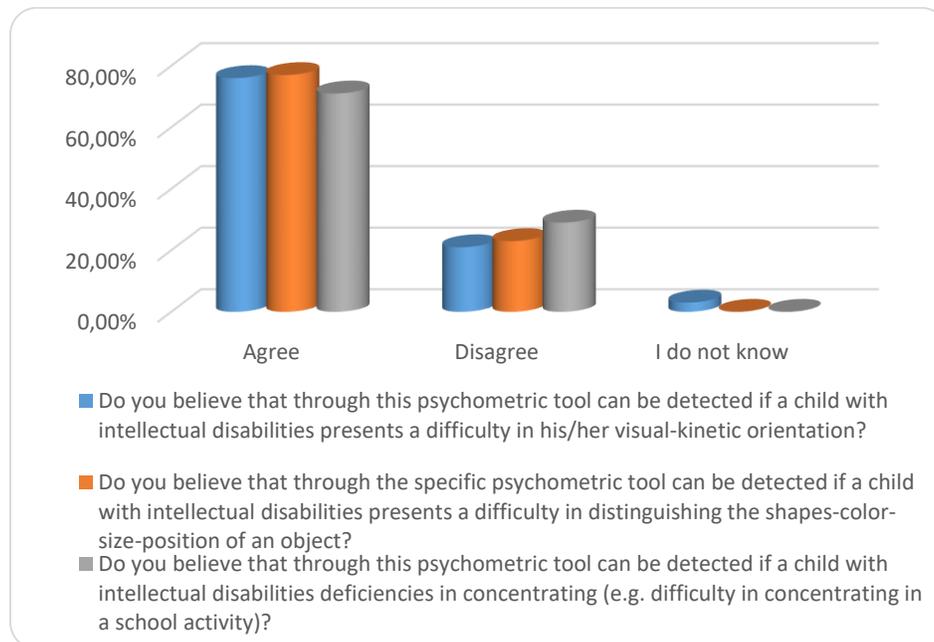


Figure 3.11. Total comparison concerning concentration-attention

Finally, from the findings it is concluded that teachers have remarkably positive perceptions on the specific psychometric test, which can help in order to detect if a student with intellectual disability present difficulties concerning concentration and attention. Specifically, 76% of them believe that the specific tool is able to detect if a child present difficulties in visual-kinetic orientation, while 21% tent to disagree with that statement and 3% answered “I do not know”. Furthermore, concerning the question “if you believe that through the specific psychometric tool can be detected if a child with intellectual disabilities presents a difficulty in distinguishing the shapes-color-size-position of an object” 77% agree and 23% of them disagree. Last but not least, 71% of the participants agree that through this psychometric tool can be detected if a child with intellectual disabilities presents deficiencies in concentrating (e.g. difficulty in concentrating in a school activity) and 29% have the opposing opinion.

According to the results from the three above questions we come in a correlation from the Wisc test which mentions that the practical part of the test is related to visual perception, visual-motor organization and the working method of constructions. The Wisc test examines the ability for proper provision of images, image completion, and image composition by the use of colored cubes, image reconstruction, and mazes.

### 3.5 Memory

Students with intellectual disability exhibit memories difficulties. The majority of the participants, about 66% agree that through this psychometric tool can be detected if a child with intellectual disabilities has disadvantages in different areas of memory (dictionary part of the test – practical part of the test). However, 33% of them have the opposite opinion, while only 1% answered “I do not know” (Figure 3.12)

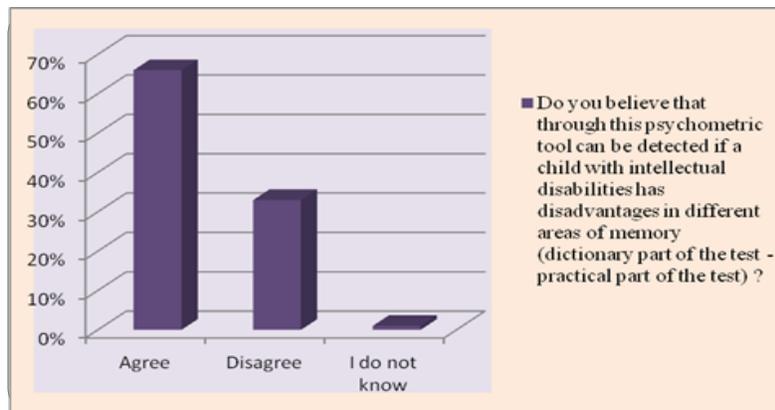


Figure 3.12. Teachers' perceptions on memory detection

Moreover, a remarkable percentage of 74% state that the specific test can help in order to detect if a child with intellectual disabilities experiences difficulties in memorizing words, schematics of concepts, images, and symbols in relation to a child of the same age without intellectual disabilities. Only 22% of the participants disagree with that statement and 4% of them answered “I do not know” (Figure 3.13). According to the literature Hoover and Wade (1985), pointed out that student with intellectual disabilities fail to remember words and concepts. Vasileiou (1998), argues that their perceptual ability and memory are at a low level, with difficulties in concentrating, in understanding abstract concepts, in numbers, in comparisons, in symbols, and they also face difficulties in conquering space, time, quantity, and size.

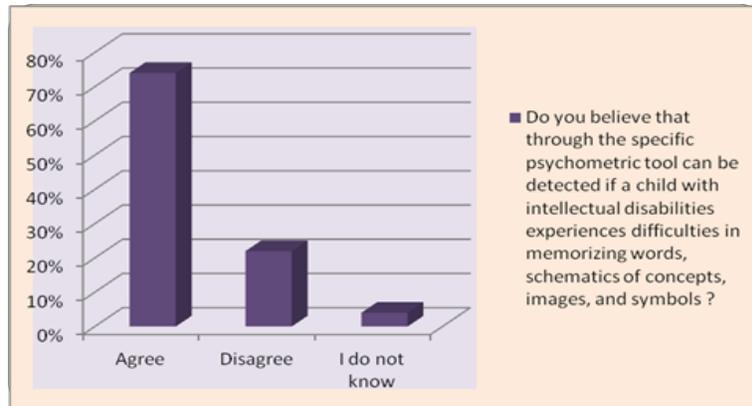


Figure 3.13. Teachers' perception on memorizing words, schematics of concepts, images, and symbols detection

Teachers' perception concerning whether this psychometric tool examines if the lack of strategic thinking is directly related to short-term memory, the majority of teachers, a percentage of 71%, agree with that statement. On the other hand, 26% of them believe that it is not an appropriate psychometric tool while only, 3% answered "I do not know" (Figure 3.14).

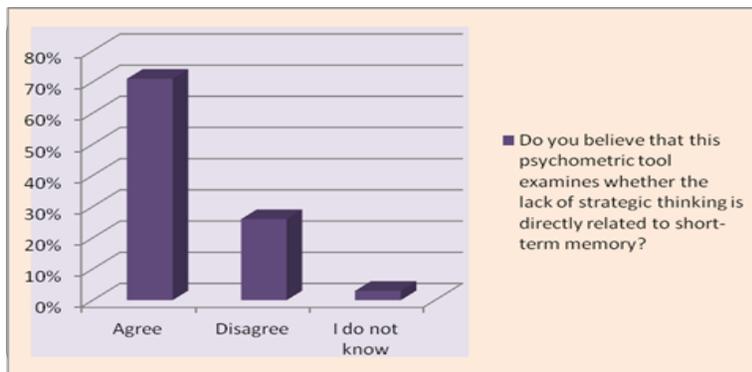


Figure 3.14. Teachers' perception on short-term memory detection

### 3.6 Linguistic-Cognitive Characteristics

At the beginning of their school year students with intellectual disabilities face difficulties especially in reading, writing and arithmetic. Another critical factor that has been examined concerning teachers opinion is whether through this psychometric tool can be detected if a child with intellectual disabilities has a lower intellectual level related to a child of the same age without intellectual disabilities (Figure 3.15). A total of 73% of respondents recognise that this tool can be useful in order to detect the intellectual level. Furthermore, 27% has a positive opinion about it. Concerning Polychronopoulou (2001), a specific characteristic of students with intellectual disability is that their intellectual level is lower than required, in order to understand the subjects being taught, and they present various difficulties such as learning and attention.

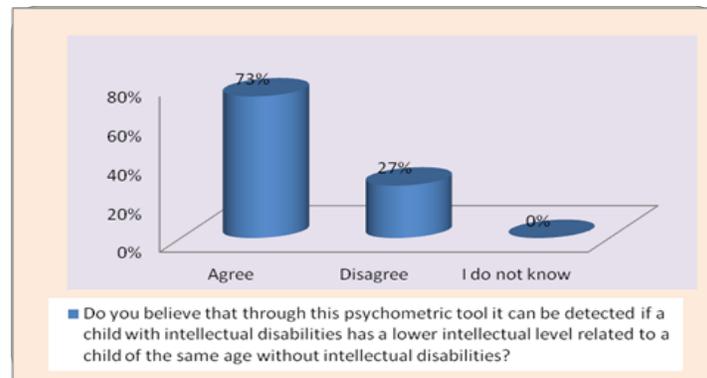


Figure 3.15. Teachers' perception on intellectual level detection

There is a positive connection between the two questions that follow, because both of them are related to language and vocabulary difficulties.

Firstly, a percentage of 76%, agree that this tool is an appropriate one, in order to detect if a child with intellectual disabilities presents language difficulties (pronunciation of words, difficulty in articulation, missing words, distortion or adding another word). As illustrated in the research of Soulis (2002), students with intellectual disability present speech disorders (delayed speech initiation). Furthermore, Dobbing (1984), argues that children with intellectual disabilities face many problems in their linguistic development: problems in the pronunciation of words, difficulty in articulation, substitution, omission, addition or distortion of sounds, problems in understanding the grammar of the written and the spoken word. On the other hand, 24% of the teachers state that this tool is not appropriate to detect language difficulties (Figure 3.16).

Moreover, the majority of the participants, a percentage of 81%, agree that with the help of this psychometric tool, can be detected if a child with intellectual disabilities presents poor vocabulary (finding the right word meaning). Only 19% of the participants disagree with that statement (Figure 3.16).

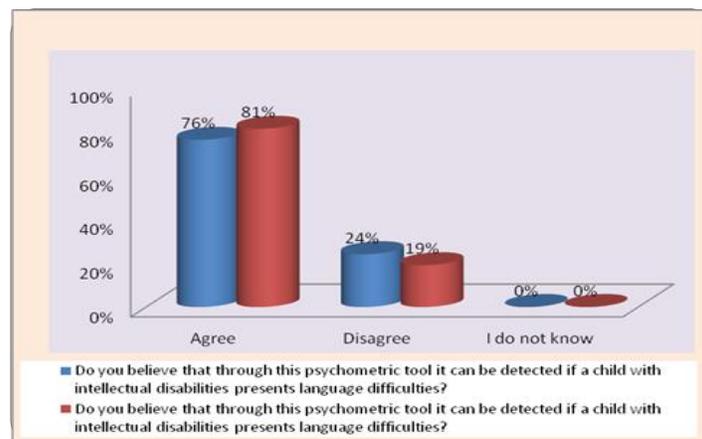


Figure 3.16. Teachers' perception on language and vocabulary difficulties detection

There is a positive correlation between the two questions that follow, because both of them are related to the writing and speaking characteristic of a child with intellectual disability.

The teachers' opinion concerning whether this psychometric tool can detect if a child with intellectual disabilities presents poor organization in thinking and speech (both in writing and speaking) was also examined. The majority of the teachers, a percentage of 79% agree, whilst, 21% of the teachers disagree with the statement (Figure 3.17). Specifically, almost four in every

five teachers have a positive opinion. Soulis (2002), argues that these children also face problems in the organization of information and in general thinking strategy. The lack of strategic thinking is connected to the problem they face in their short term memory.

A remarkable percentage of 89% of the sample state that through this psychometric tool can be detected if a child with intellectual disabilities faces difficulties in understanding texts (finding a hero, central idea of a text, distinguishing significant from insignificant information) (Figure 3.18). Specifically, almost nine in every ten teachers agree with that statement (89%). However, there is also a small percentage of participants (11%), who believe that this test is not appropriate in order to detect difficulties in understanding texts. Soulis (2002), pointed out that children with intellectual disability present deficit understanding in text (symbolic content, consequences of events).

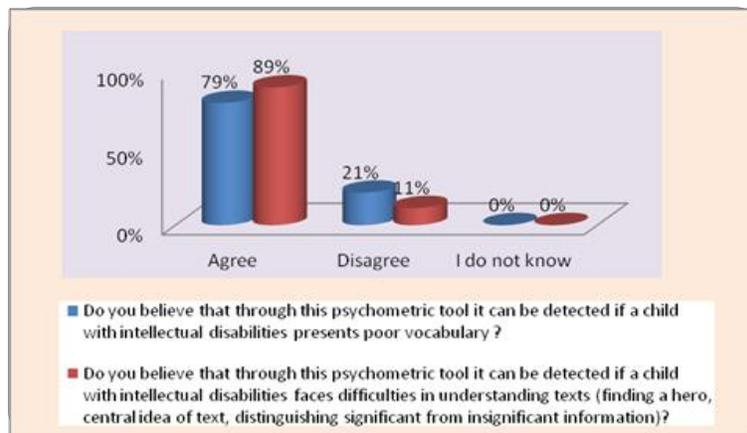


Figure 3.17. Teachers' perception on writing and speaking detection

Last but not least, teachers' perception concerning whether this psychometric tool can detect if a child with intellectual disabilities can generalize his general knowledge in his daily life has been also examined. The percentage of 59% of the sample has a positive opinion about it, whilst, 37% disagree with that statement (Figure 3.18). According to Soulis (2002), a characteristic of students with intellectual disability is that they face problems in the organization of information and in general thinking strategy.

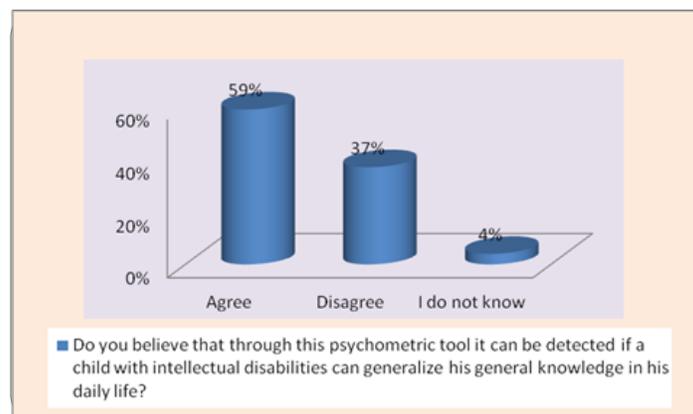


Figure 3.18: Teachers' perception on general knowledge detection

### 3.7 Mathematical characteristics

There is a positive correlation between the three questions that follow, because they are related to the mathematical characteristics of students with intellectual disabilities.

According to Christakis (2006), students with intellectual disabilities face difficulties in solving mathematical problems in editing geometric symbols, in understanding abstract concepts, in mathematical thinking and in understanding concepts with visible morphological characteristics. According to Hoard et al. (1999), students with intellectual disabilities face difficulties in developing mathematical skills and they need special attention in their acquisition. Moreover, according to DSM-IV, the disorder of mathematics, as it is called, is characterized by a reduced ability of the child for mathematical computations and operations (e.g. understanding mathematical terms, acts, concepts or symbols, correct number copying and execution of specific acts, addition with carrying, etc.). Last but not least, Johnson and Myklebust (1967), argue that difficulties in mathematics may affect the whole range of mathematical knowledge, from numbering to problem solving. In addition to the above mentioned mistakes, children with intellectual disabilities face difficulties in numbering and in measuring, ascending or lowering the line (one, two, two, three, etc.).

Firstly, a remarkable percentage of 90% the sample state that through this psychometric tool can be detected if a child with intellectual disabilities presents difficulties in understanding symbols and in mathematical terms. However, there is also a small percentage of 10% who has an opposite opinion (Figure 3.19).

Secondly, a percentage of 84% agree that through this psychometric tool can be detected if a child with intellectual disabilities experiences difficulties in calculating mathematical problems (understanding, problem-solving strategies). On the other hand, 16% of the teachers state that this test is not appropriate in order to detect difficulties in calculating mathematical problems (Figure 3.19).

Last but not least, Figure 3.19 also presents the teachers’ perceptions whether this psychometric tool can detect if the child with intellectual disabilities presents difficulties in performing certain mathematical operations (addition, subtraction, multiplication, division). On the one hand, 87% of the teachers agree, while a percentage of 13% disagree. On the other hand, none of them answered “I do not know”.

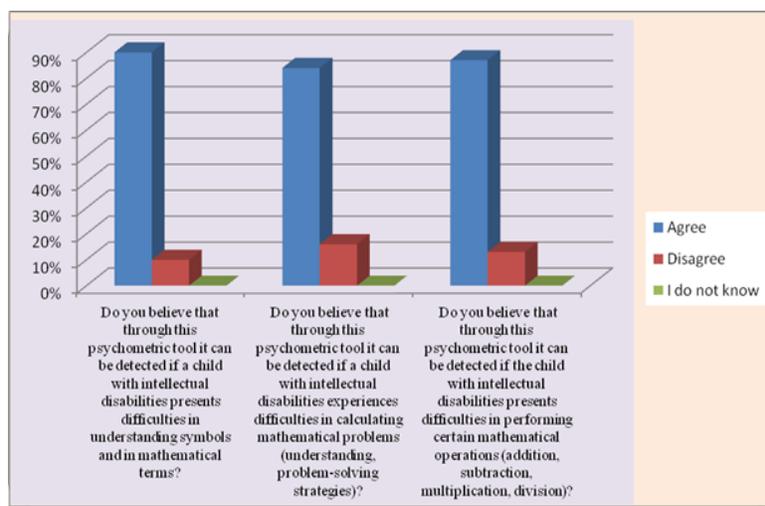


Figure 3.19. Teachers’ perception on mathematical characteristic detection

### 3.8 General perceptions

The main finding in this research (26<sup>th</sup> question), is that the specific psychometric tool can help in diagnosing intellectual disabilities (Figure 3.20). 91% of the teachers agree that the specific test is an appropriate tool in order to detect intellectual disability, whereas just a percentage of 9% has an opposite opinion. The conclusion is that there is a large deviation between “Agree” and “Disagree” statement.

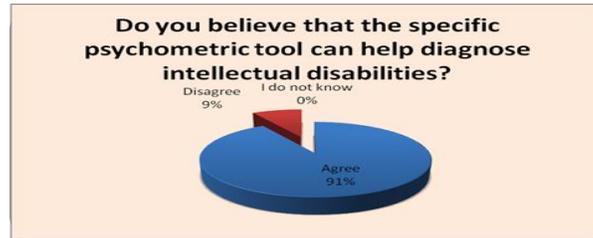


Figure 3.20. Teachers’ perception whether the specific psychometric tool can help in diagnosing intellectual disabilities

The teachers who took part in the specific research, they also answered in an open question, the following one: “Do you believe that is important some parts of the test to be changed?” Specifically 84% argue that the form of the test is satisfactory and only 16% from them answered that the test is important to be changed (Figure3.21).



Figure 3.21. Teachers’ perception on changes concerning the psychometric test

### 3.9 Comparisons and conclusions

#### 3.9.1 Comparing highest and lowest values

The highest value in the general question is observed in the statement whether the specific psychometric tool can help in diagnosing intellectual disabilities. A percentage of 91% of the teachers agree that this test can detect intellectual disability. The lowest value is zero and is detected only in the answer “I do not know”. Some of the questions with the lowest value are: the general question and the statement whether the teachers believe that through this psychometric tool can be detected if a child with intellectual disabilities presents difficulties in understanding symbols and in mathematical terms (these two questions were chosen, because they also include the highest value of the statement “Agree”).

#### 3.9.2 Analysing results

The highest value is observed in the general question, with 91% of the participants, and the lowest value is detected in the question of psychological characteristics, which is whether the teachers believe that this psychometric tool can detect the mental fatigue of children with

intellectual disabilities with a percentage of 47%. Most significantly is that the general question includes also the lowest rate, with a percentage of 9%, and moreover, the other question, has also the highest value with 44% (Figure 3.22). The above totals suggest that firstly, almost everyone agree that the specific psychometric test can detect intellectual disability. Secondly, it shows that there is a strongly correlation between the answers of the teachers concerning mental fatigue.

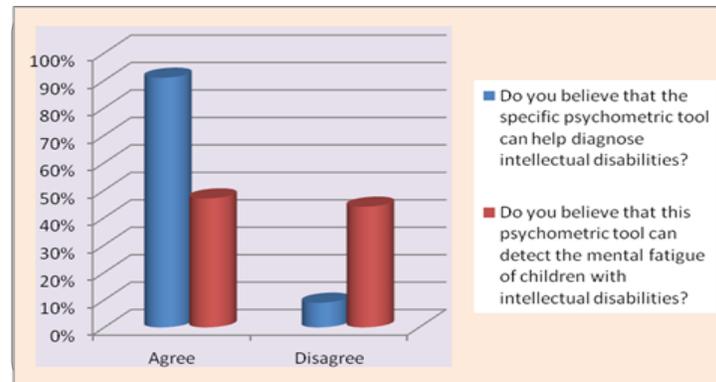


Figure 3.22. Highest and lowest values

#### 4. Discussion and conclusion

This survey interprets whether the psychometric test that have been constructed by me, is an appropriate tool in order to detect intellectual disability regarding to teachers' opinion. With reference to the seven broad categories of the research, the sample which was the special school teachers appeared to argued that the specific test is an appropriate tool in order to detect psychometric test. From the results of the linguistic-cognitive and mathematical categories, we conclude that this tool is able to diagnose intellectual difficulties.

In this study, all the data are divided into six categories so as the validity of the results to be more understandable: speed-processing information, psychological characteristics-spiritual, fatigue-social characteristics, concentration-attention, memory, linguistic-cognitive characteristics and mathematical characteristics. A general perception and an open question are also included.

From the teachers' answers as most people agree that the particular psychometric is suitable for diagnosing a mental one, the time period of the results of the diagnostic assessment of the children will be limited. Since it is necessary to diagnose and formulate the most appropriate methods of intervention. It will also give an insight into the current situation of the child in important areas and areas that need appropriate and immediate intervention.

From the teachers' answers as most of them agree, we conclude that this psychometric tool is suitable for the diagnosis of intellectual disabilities. Furthermore, it will give an insight into the current situation of the child in important areas and areas that need appropriate and immediate intervention.

The diagnosis of intellectual disability through this psychometric tool is necessary for the school performance of pupils with mental retardation. Depending on the degree of intellectual disability, students will join either regular school in inclusion classrooms or special schools where their education will be tailored to the student's needs. Thus, a proper special education will be developed in order their personality and their skills to be improved, and pursue their future professional training in order to achieve equal social development.

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## Special Needs Teachers' Perceptions on the Educational Digital Game the "Four Forces"

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### *Abstract*

It is a well known fact that there is a discrete group of pupils with severe problems in the acquisition of mathematical skills. These problems go beyond a quantitative range, but differ qualitatively from the ways the pupils gain mathematical knowledge from their teachers in the classroom. The central thesis of this survey is the development of the educational digital game the "Four Forces", and the teachers' perceptions concerning whether the specific digital game reduce mathematic and memory difficulties in students with intellectual disabilities. This was achieved by comparing and contrasting the teachers' perceptions on this particular issue through questionnaires via e-mail. Through the survey findings it has been observed that special needs teachers have similar perceptions about the digital math games, which they agree that they could enhance students' cultivation of memory capacity and could improve the development of numerical skills.

**Keywords:** Intellectual disabilities, mathematical difficulties, memory difficulties, digital game, teachers' perceptions.

### 1. Introduction

The central thesis of this survey is the development, implementation and evaluation of an educational digital game for reducing mathematic and memory difficulties in students with mental disabilities, compared to the traditional learning in school. The survey aims to give insight within a short time, into visible improvement of students' image in the field of mathematical awareness and the development of numerical skills.

As it is known, on the basis of the development of individual skills in different areas of learning, it is always the development of one or more skills in cognitive development. The development of numerical skills, and generally the development of learning skills in mathematics seem to be directly related to the mnemonic capacity of the student and various distinctive functions (Christakis, 2006). Two threads of research are examined: the cultivation of memory capacity and the development of arithmetic skills.

- Teachers’ perceptions on memory and learning.
- Teachers’ perceptions on memory and Mathematics.
- Teachers’ perceptions on learning difficulties in Mathematics.
- The effect of the digital game the “Four Forces” both in the mnemonic capacity and arithmetic performance.

Proceeding from the study’s purposes, the survey will obtain the following objectives:

- the construction and implementation of an educational digital game for the systematic teaching and development of arithmetic skills and mnemonic capacity of students with moderate mental disabilities under the guidance of the curriculum students with disabilities.
- the study of the effect of the program and the evaluation of the results both in the mnemonic capacity and arithmetic performance.
- the study of the psychosocial dimensions of students with moderate mental disabilities.
- the useful conclusions in order to conduct future similar surveys in the context of school.

## 2. Methodology

### 2.1.1 *Research approach*

A deductive approach was used to undertake this research. Initially, the literature was used to identify theories and ideas and proceeded to a more specific conclusion by using data. Saunders et al. (2003), point out that the deductive approach gives priority to: scientific principles, moving from theory to data, the collection of quantitative data, the application of controls to ensure validity of data, a highly structured approach, and necessity to select samples of sufficient size in order to generalise conclusions.

### 2.1.2 *Research strategy*

A survey strategy was deemed the most appropriate research tool, as Saunders et al. (2003), suggest this strategy is the most suitable when taking the deductive approach. Surveys can be obtained using questionnaires and the data is standardised enabling correlations. Furthermore, surveys, are easily understood because they indicate, for example, a certain percentage of teachers’ perceptions. Questionnaires are one of the data collection methods that belong to the survey strategy (Saunders et al., 2003).

### 2.1.3 *Collecting primary data using questionnaires*

Firstly, the primary data was collected by using questionnaires. All of the questionnaires were sent via e-mail to special need teachers. Questionnaires are one of the most popular methods of conducting scholarly research (Rose & Grosvenor, 2001). According to Rose and Grosvenor (2001), they carry with them an aura of scientific respectability. Because they use numbers and can present findings in the form of graphs and tables, they convey a sense of solid, objective research. Furthermore, questionnaires are easy to analyse, and most statistical analysis software can easily process them. Written questionnaires become even more cost effective as the number of research questions increases. Gugg and Petre (2007) have pointed out that questionnaires are also familiar to most people. Nearly everyone has had some experience completing questionnaires, and they generally do not make people apprehensive. When

respondents receive a questionnaire in the mail, they are free to complete it in their own time (Denscombe, 2003).

Conversely, Pickard (2007) argues that questionnaires are simply not suited for some people. Often, potential respondents are unwilling to fill in written questionnaires because they are poorly prepared and/or written. Furthermore, when returned questionnaires arrive in the post, it is natural to assume that the respondent is the same person you sent the questionnaire to. A number of researchers have reported that this may not actually be the case (Cohen et al., 2007). In a summary of five studies sponsored by the British Government, Scott (1961) reports that up to ten percent of the returned questionnaires had been completed by someone other than the intended person. For a variety of reasons, the respondent may not be who you think it is. It is a confounding error inherent in questionnaires.

In order to conduct the research, the questionnaires were administered on line, via e-mail, in order to be more cost effective. Moreover, the most widely used scale, which was devised by Likert was used. The Likert scale is made up of a number of positive and negative statements relating to the attitude being measured and the respondents are asked to indicate, using a numerical scale, the extent to which they agree or disagree with each statement.

As suggested by Saunders et al. (2003), maintenance was given also to the design of questions, the clear layout of the questionnaire form, explanation of the purpose of the questionnaire, and pilot testing, since all these factors contribute to bigger response rates, validity and reliability.

First of all, the questionnaire was designed in such a way that data collected could be measurable. Moreover, as suggested by Bourque and Clark (1994), apart from the researcher's own questions, ones used in other questionnaires were adopted and adapted in order to replicate and compare the findings with other studies. The questionnaire was prepared with careful consideration for the respondents, in order to ensure a high response rate. Careful attention was paid to the order and flow of the questions so that were in a logical order for the respondents. Furthermore, it was assured that the questionnaire was easy to read and the responses were easy to fill in. Additionally, a cover letter was included in order to explain the purpose of the survey and encourage teachers to respond.

#### *2.1.4 Collecting secondary data*

Subsequently, secondary data was collected. Secondary data is data that has already been collected and collated by somebody, for some reason, other than the current study. It can be used to get a new perspective on the current study, to supplement or compare the work or to use parts of it (Saunders et al., 2003).

The secondary data include three main types of data: documentary, survey and those from multiple sources. They include journals, academic's surveys and books. Secondary data help researchers for statistical measures, for instance, the educational beliefs derived from teachers. Furthermore, it helps to triangulate findings derived from primary data collected through questionnaires. Finally, the main advantage of using secondary data is that it saves both time and money.

#### *2.1.5 Selecting samples*

Sampling techniques involve selecting individual units to measure from a larger population, providing readers with a clear understanding of the applicability of the study to their

particular situation and their understanding of the same population. This suggests that sampling saves researchers' time and reduces cost (Roberts, 2004).

There are two main types of sampling techniques: probability sampling and non-probability sampling. Denscombe (2003) argues that, probability sampling is a sampling technique wherein the samples are gathered in a process that gives all the individuals in the population equal chances of being selected.

Concerning the size of the sample, Saunders et al. (2003), state that when there is a sample of at least 30 responses, the level of certainty reaches, normally, 95%. The margin of error characterises the accuracy of the estimates of the society.

#### *2.1.6 Response rate*

Sufficient response rates are important for surveys. The percentage of people who respond to surveys is considered the response rate. A high survey response rate helps to ensure that the survey results are representative of the survey population (Rugg and Marian, 2007). The following equation is used to calculate the response rate for a survey:

$$\text{Response Rate} = \text{Number of Complete Surveys} / \text{Number of Participants Contacted}$$

In questionnaire surveys undertaken in North American universities the response rates ranged from 50 to 65% (Willimack et al., 2002).

#### *2.1.7 The technique for collecting the sample*

A purposive sampling technique was used in order to collect data, using questionnaires, which allow judgement to be used in the selection of cases that will best enable the research question to be answered and to meet the outlined goals. Based on Willimack et al. (2002), who note that a usual response rate ranges from between 50 and 65%, 140 e-mail questionnaires were sent to teachers in order to ensure a minimum response rate of 70. Furthermore, it should be mentioned that the population is homogeneous (special need teachers). The participants were chosen because they have particular features or characteristics which, therefore, will enable the detailed exploration of the research objectives.

### *2.2 Data results*

#### *2.2.1 Analysing quantitative data*

The data were prepared with quantitative analysis in mind, in order to use different charting and statistical techniques. Data were entered for computer analysis, in which each column represents a variable and each row a case. Coding data helps researchers to save time, to test their findings in a better way and finally to make comparisons with other surveys (Denscombe, 2003). Quantitative data according to Saunders et al. (2003) are the following: (1) represented and summarised in numerical form; (2) collection results in numerical and standardised data; and (3) analysis conducted through statistical methods.

Data were divided into eight categories, in order to be more accurately measured. These categories concern the "Demographics" of the participants and the teachers' perceptions concerning "Memory and Learning", "Memory and Attention", "Memory and Mathematics", "Metacognition-Metamemory", "Learning difficulties in Mathematics" and their perceptions concerning "The Digital Game". The last category aims to find out teachers' different perceptions on the digital game the "Four Forces".

Initially, the relationships and differences were examined by comparing variables. Both tables and diagrams were used in order to explore the data. More specifically, tables were used to show specific values, bar charts and multiple bar charts to show highest and lowest values. Pie charts and percentage component bar charts were also used to show proportions. Consequent analysis will involve describing the data and exploring relationships. Through the adoption of the Excel Microsoft software, this task will be less time consuming.

### 2.2.2 Findings

As Saunders et al. (2003) argue, the theory, depends, apart from the design of the research, on the reliability and validity of the research findings and conclusions.

## 3. Results

### 3.1.1 Response rate

From a sample of 140 cases (questionnaires sent to special need teachers as explained in the methodology – “sampling technique”), 70 responses were received, a total response rate of 50 per cent (70/140). This response rate meets Willimack’s et al. (2002) research findings, who found that for survey questionnaires in North American Universities, the response rates range from 50 to 65 per cent.

### 3.1.2 Demographics

So far, 70 special need teachers take part in the survey by completing the questionnaires. 44 of them were women (63%) and 26 were men (37%). Most of the participants were aged 35-44 (54%). Furthermore, most of them (64%) had a Master in Special Education or School Psychology, while only 10 participants (14%) had a PhD in Special Education or School Psychology. 39 of the participants (56%) currently work in the Special Vocational Education and Training Laboratories. Finally, 8 special need teachers report that they have up to 4 years (11%) of service, 56 of them work from 5-10 years (80%), 6 of them work from 10-15 years (9%), and no one has 16 or more years of service.

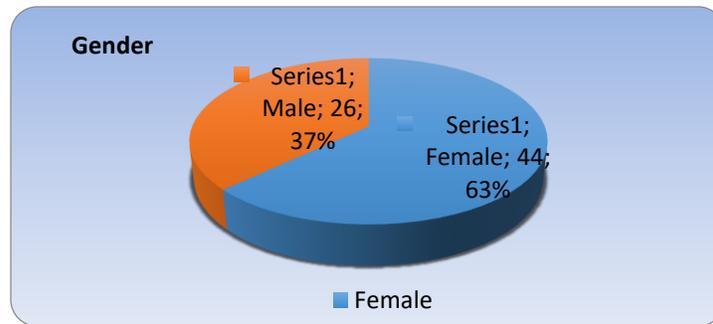


Figure 3.1. Gender of the participants

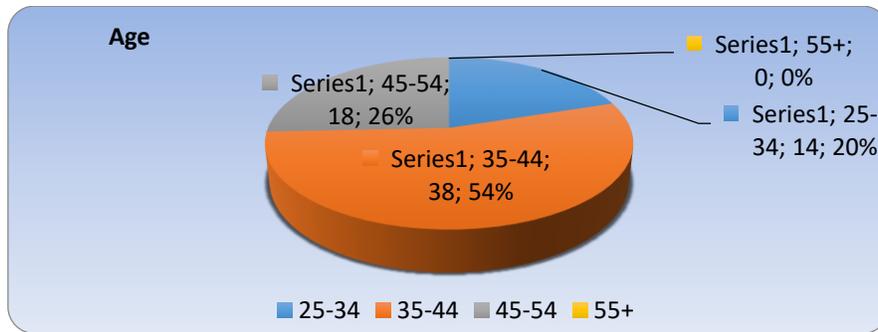


Figure 3.2. Age of the participants

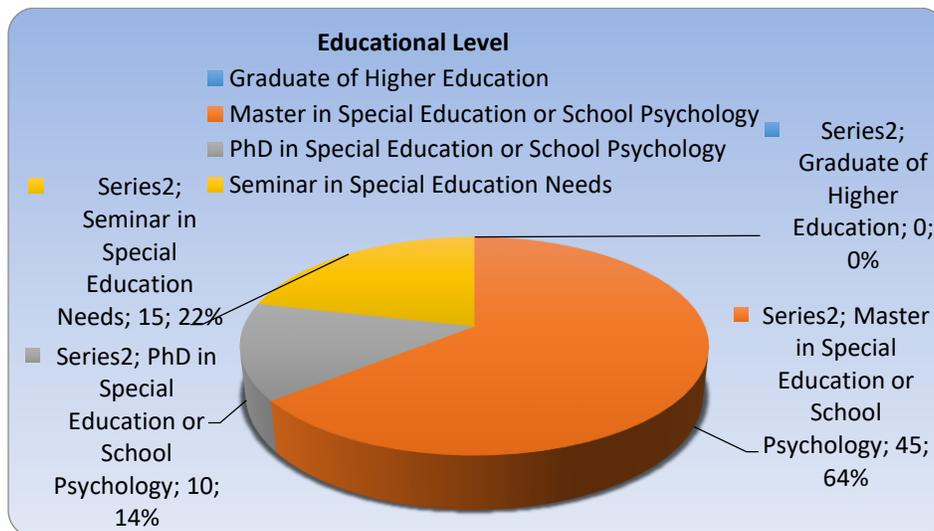


Figure 3.3. Educational level of the participants

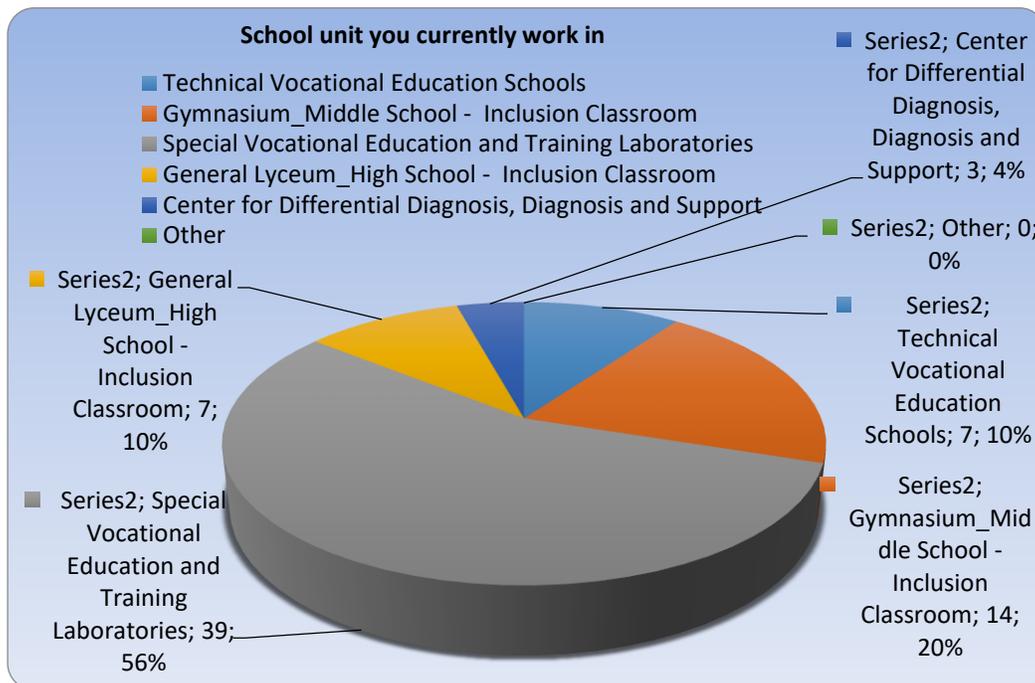


Figure 3.4. School unit the participants currently work in

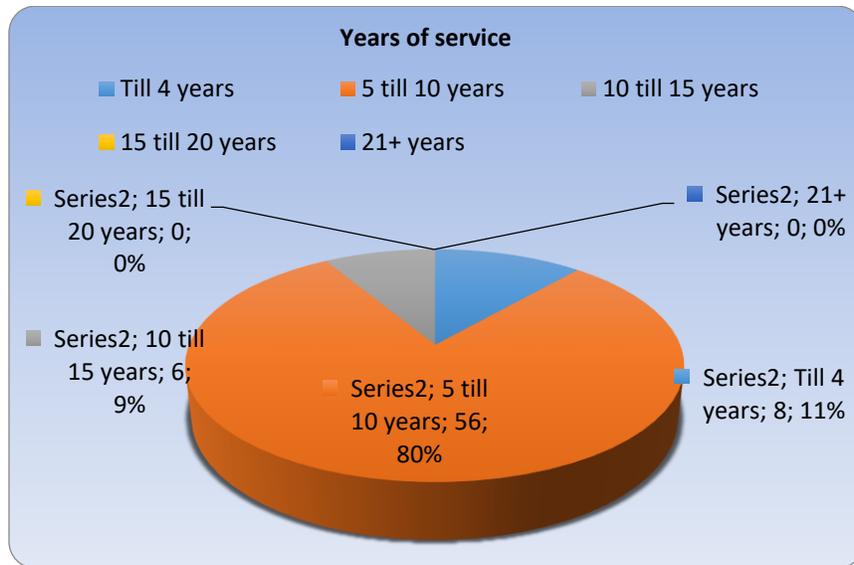


Figure 3.5. Years of service of the participants

### 3.1.3 Memory and learning

From the literature, it was found that memory is one of the five core functions of the human mind. Furthermore, it is known that the mnemonic capacity, as other capacities of the person, is possible to be improved after exercises, and the memory capacity will be increased. Especially, in Mathematics, as it has been noted by many researchers, the memory and various functions, play a determining role. Accordingly, the sixth and the seventh questions of the questionnaire were about the teachers' perceptions concerning memory and learning of Mathematics (Figure 3.6). From the results of the questionnaire, it was found that a total of 70% agree that memory plays a determining role in Mathematics, whilst 30% disagree with this statement. In comparison, these results were very similar to those concerning teachers' perceptions on the facilitation of the mnemonic function of students with intellectual disability, while using the specific digital game during teaching. 80% believe that the specific digital game will facilitate the mnemonic function of students with intellectual disability, whilst only 20% disagree with that statement. These results are in accordance with those reported by Hall and Gold (1990), who stated that if a person finds the information enjoyable and exciting, adrenaline exudes, which increases the level of glucose in the blood that is available to the brain, and as a result, it facilitates the mnemonic function and the consolidation of memories.

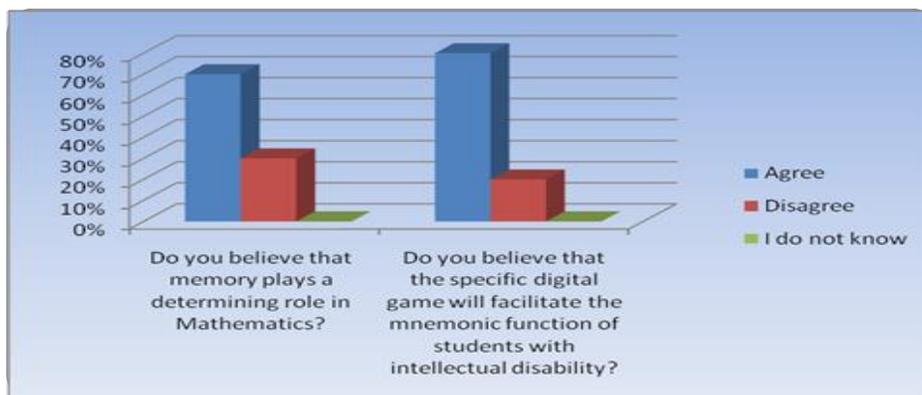


Figure 3.6. Teachers' perceptions concerning memory and learning of Mathematics

### 3.1.4 Memory and attention

Moreover, one of the factors which was examined through the questionnaires, was whether the digital game “Four Forces” will help the consolidation of memories of students with intellectual disability (figure 3.7). Among the participants, 77% agree, 20% disagree while only 3% do not know. According to the model of Norman and Shallice (1980), the memory of an event is directly linked to the attention given by the person when the stimulus is caused. Additionally, it is obvious to all investigations that the result in a work is a combination of both memory and the attention that the individual shows.

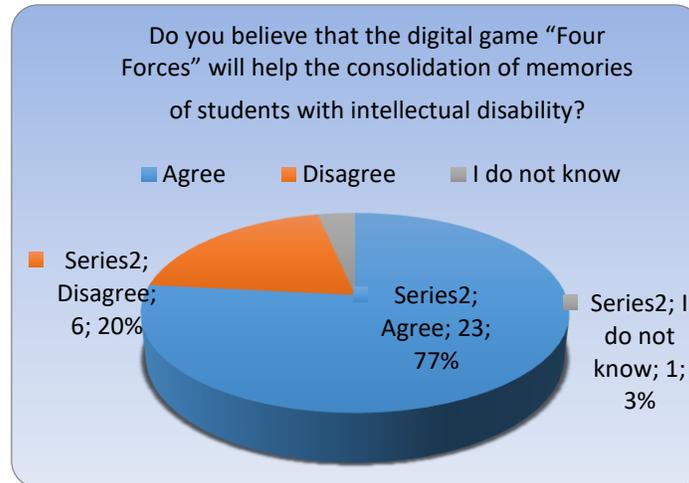


Figure 3.7. Teachers’ perceptions concerning the consolidation of memories of students with intellectual disability by the help of the digital game the “Four Forces”

Furthermore, from the questionnaire it was determined that 70% of the teachers agree that most of the correct answers to each section of the digital game are a combination of both memory and attention of each student, while 23% disagree with the above statement and only 7% do not know (Figure 3.8). These results are in accordance with those reported by Goldman et al., 1998, who stated that if the student at a complicated arithmetic problem has not in his mind with directness and clarity the data, and he needs to commit a significant portion of his attention and his short-term memory, then, he gets tired, and he cannot respond adequately to all the claims of a complex project.



Figure 3.8: Teachers’ perceptions concerning that most of the correct answers to each section of the digital game are a combination of both memory and attention of each student

### 3.1.5 Memory and mathematics

One major factor that was also researched through the questionnaire was teachers' perceptions on memory and Mathematics (Figure 3.9). In the tenth question from the questionnaire an overwhelming total of 76% recognise that the initial part of the digital game, which is relevant to the theory of each mathematical unity, helps the memorization of students with intellectual disability, while only 24% of the teachers do not agree with this statement. The above results are similar to those reported by Skemp (1976), who notes that the understanding may be an instrumental understanding, which among others, supercharges the memory or the relational understanding, which besides being maintained more easily in the memory, it is also adjustable in new situations and can form the basis for further conceptual development. Moreover, the majority of the teachers, a percentage of 78%, agree that the digital game "Four Forces" helps most students with intellectual disability to maintain in memory mathematical concepts, while, on the other hand, it is encouraging that only 22% of the respondents disagree with that statement.

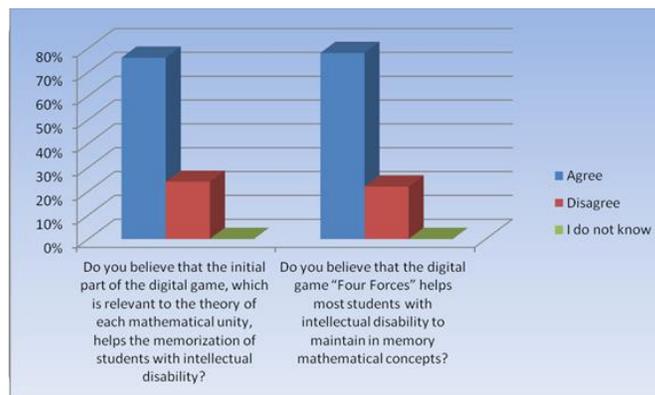


Figure 3.9. Teachers' perceptions concerning memory and Mathematics

The twelfth question was whether the specific digital game will help students with intellectual disability adjust mathematical concepts in new situations in their everyday life (Figure 3.10). It was found that the majority of teachers, a total of 63%, agree with the statement, whilst 37% disagree.

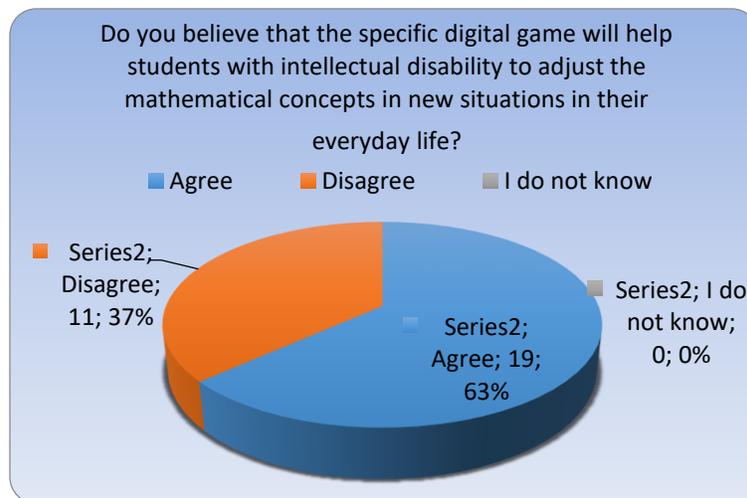


Figure 3.10: Teachers' perceptions concerning whether the specific digital game will help students with intellectual disability adjust mathematical concepts in new situations in their everyday life

### 3.1.6 Metacognition-metamemory

Furthermore, through the questionnaire, was researched the teachers’ perceptions on whether the specific digital game is an appropriate tool in order to make pupil’s metamemory more effective (Figure 3.11). Among the participants, 46% agree, 43% disagree while 11% do not know. As it is observed, there is a strong correlation between the answers. From the literature, it was found that the term metamemory is part of the phenomenon of metacognition and means awareness of the existence of memory as well as the knowledge that memorizing ability can be made more effective by using the appropriate method each time and in the specific case is the daily use of the digital game during the teaching.

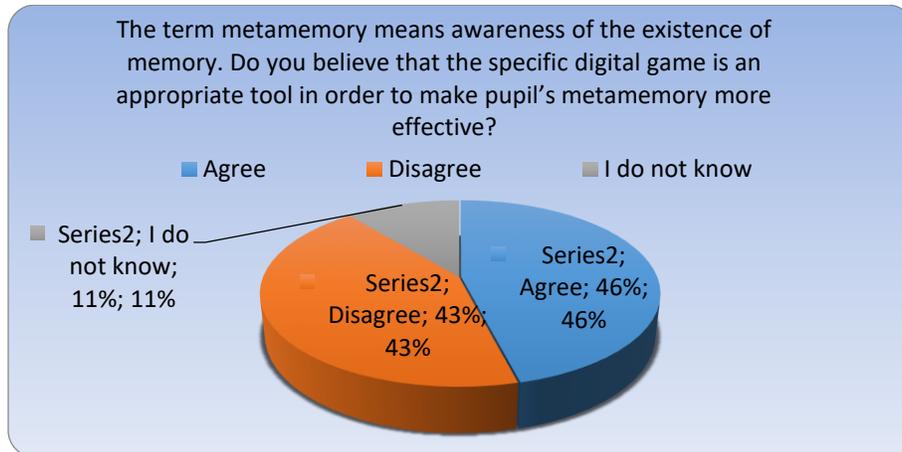


Figure 3.11. Teachers’ perceptions on whether the specific digital game is an appropriate tool in order to make pupil’s metamemory more effective

Furthermore, from the questionnaire it was observed that 63% of the teachers agree that the “Four Forces” will help students with intellectual disabilities develop math strategies more easily, while 27% disagree with the above statement and only 10% do not know (Figure 3.12).

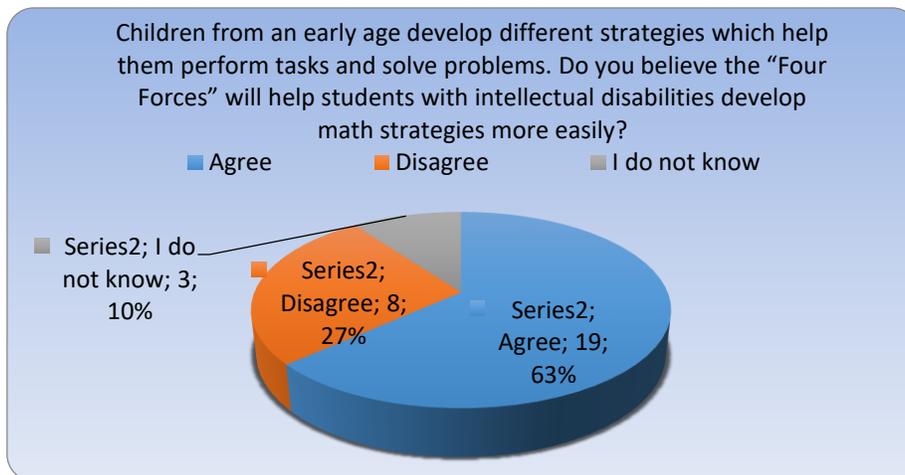


Figure 3.12. Teachers’ perceptions on whether the “Four Forces” will help students with intellectual disabilities develop math strategies more easily

The fifteenth question was whether the “Four Forces” help the self-regulatory of cognitive behavior of those students (Figure 3.13). The majority of the respondents, a percentage of 73% agree with the above statement, with 23% of them disagreeing and 4% not know. The above

results are similar to those reported by Wong and Jones (1982), who notes that the self-regulatory of cognitive behaviour of students, which is the conscious modification of behaviour by the individual in order to achieve a goal, is another basic difficulty posed by students with learning disabilities, which can be taught.

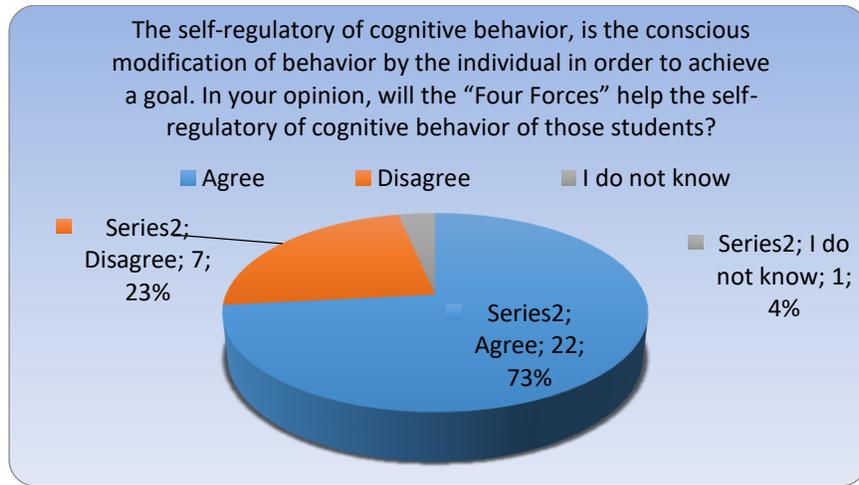


Figure 3.13. Teachers’ perceptions on whether the “Four Forces” help the self-regulatory of cognitive behavior of those students

### 3.1.7 Learning difficulties in mathematics

Another major factor that was also researched through the questionnaire was teachers’ perceptions on whether the digital game the “Four Forces” help students with intellectual disabilities face learning difficulties in Mathematics (Figure 3.14). Specifically the sixteenth question was about whether the specific digital game helps students with intellectual disabilities face difficulties in numbering and measuring, ascending or lowering the line, as well as difficulties in understanding the meaning and value of numbers. An overwhelming total of 72% agree with the statement, with only 28% of them disagreeing.

Furthermore, from the questionnaire it was determined that 77% of the teachers agree that the “Four Forces” will help students with intellectual disability learn how to select and use appropriate strategies in order to recall basic numerical data of a mathematical problem, whilst only 23% of them disagree with this statement.

The eighteenth question was whether the specific digital game will help students with intellectual disabilities restructure and use the mathematical models and rules that have been taught in new contexts, since it is characteristic that these children usually remain “devoutly” committed to the way they have received the knowledge. The majority of the respondents, a percentage of 74% agree. However, only 26% has the opposite opinion. These results also conform to the findings of Tishler (1981), who advises that these children usually remain “devoutly” committed to the way they have received this knowledge, unable to proceed to the reconstruction and use of mathematical models and rules that have been taught in a new context, presenting a cognitive rigidity.

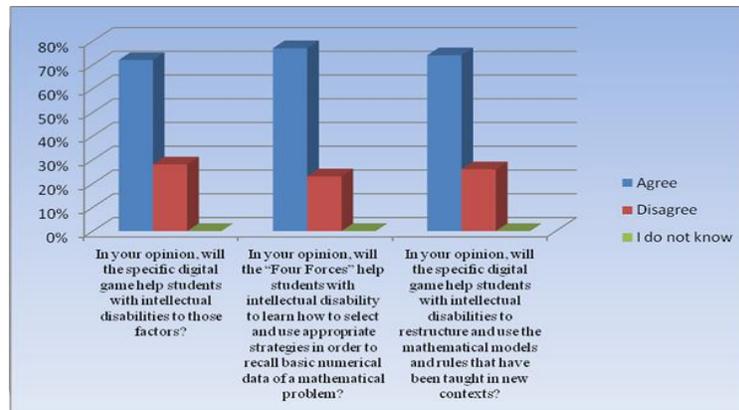


Figure 3.14. Teachers’ perceptions on learning difficulties in Mathematics

### 3.1.8 The digital game

Moreover, through the questionnaire, was examined the digital game the “Four Forces”, which was created (Figure 3.15). Among the participants 79% agree with the statement that the digital game will help students with intellectual disability understand better and remember mathematical symbols while a 21% tend to disagree with this statement. Additional, in this survey the findings illustrate a percentage of 87% of the participants who believe that the “Four Forces” will help students with intellectual disability understand better geometric shapes. 80% agree with the statement that the digital game will help students with intellectual disability to identify better symmetry and patterns in everyday life, whereas 20% have a different opinion. Concerning the learning of better conception of time by using the specific digital game, 81% of the participants agree, whilst only 19% of them disagree with the statement. Moreover, 83% of the teachers agree that the “Four Forces” will help students with intellectual disability learn better and be able to distinguish the months and the seasons on the other hand, 17% of the participants disagree with the statement. The majority of teachers, a total of 84%, agree that the specific digital game will help students with intellectual disability learn easier about Euro money, with only 16% disagreeing with this statement. Last but not least, 70% of the participants agree with the statement that the “Four Forces” will help students with intellectual disability learn easily the value of money and consequently the term of savings.

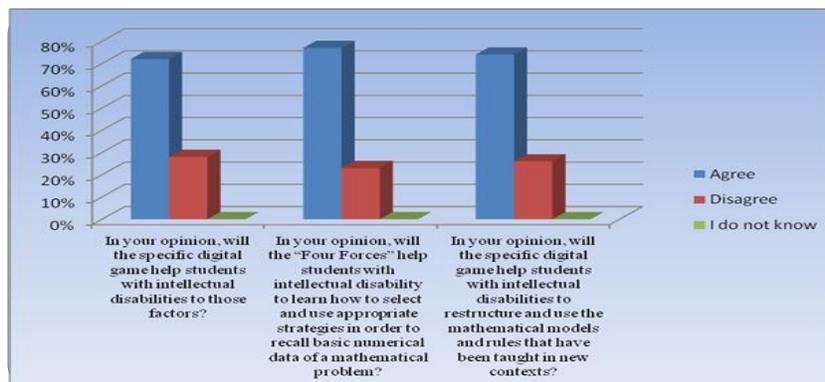


Figure 3.15. Teachers’ perceptions on the digital game

### 3.1.8 General perception

The main finding of the survey is that most of the teachers believe that the digital game the “Four Forces” will affect on the development of both the mnemonic capacity and the numerical skills of students with intellectual disability (Figure 3.16). The majority of the respondents, a percentage of 93% agree. However, only 7% has the opposite opinion. Finally, none of the participants are neutral.

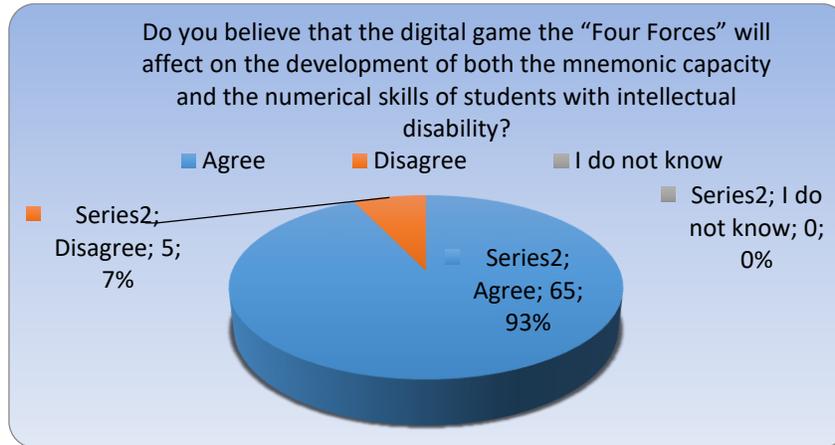


Figure 3.16. Teachers’ perceptions on the digital game

The special need teachers who took part in the specific research, they also answered in an open question, the following one: “Do you believe that the digital game the “Four Forces” you have been given can be improved?” Specifically 80% of the participants believe that the digital game the “Four Forces” does not need to be modified in order to be improved whilst only 20% from them has a contrary view (Figure 3.17).



Figure 3.17. Teachers’ perception on whether the digital game the “Four Forces” can be improved

### 3.1.9 Correlations and conclusions

#### Comparison between the highest and the lowest rates

The highest rate is detected in the general question where the participants have to answer whether the digital game the “Four Forces” will affect on the development of both the mnemonic capacity and the numerical skills of students with intellectual disability. 93% of the respondents tend to agree with the above statement. The lowest value is zero and is observed in the answer “I do not know”. Furthermore, there are also some questions with the lowest value.

These are the general question as mentioned above and the twentieth question, “Do you believe that the “Four Forces” will help students with intellectual disability understand better geometric shapes?” (These two questions have been also chosen, because they also conclude the highest value of the statement “Agree”).

### *Comparing totals*

The highest value is observed in the general question, with 93%, and the lowest value is detected in the thirteenth question (“The term metamemory means awareness of the existence of memory. Do you believe that the specific digital game is an appropriate tool in order to make pupil’s metamemory more effective?”) with a percentage of 46%. Most significantly is that the general question also includes the lowest rate, with a percentage of 7%, and moreover, the 13th question, has the biggest value of the statement “Disagree” with 43% (Figure 3.18). The above totals suggest that almost everyone agree that the digital game the “Four Forces” could enhance students’ cultivation of memory capacity and improve the development of numerical skills.

Last but not least, the 13<sup>th</sup> question shows that there is a strongly correlation between the answers of the teachers concerning metacognition and metamemory.

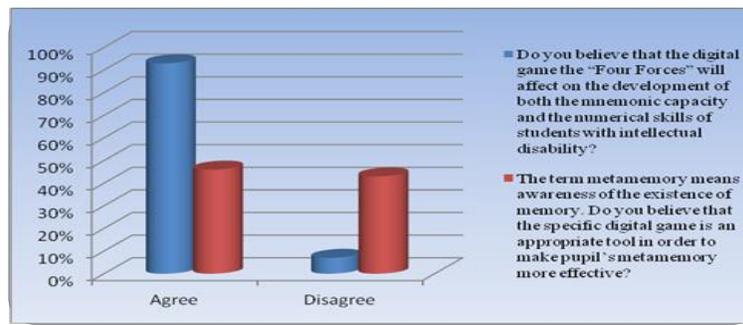


Figure 3.18. Highest and lowest total values

## 4. Discussion and conclusions

Proficiency in mathematics is a major determinant of a pupil’s future success. A comprehensive teaching approach and also teachers’ perceptions about students with intellectual disabilities are necessary to address the many problems those pupils face during their school life.

The digital game the “Four Forces” will help to develop the students’ knowledge and furthermore is going to help them successfully participate in all the educational situations that negotiate important concepts of Mathematics and memory.

Participants’ answers show that they believe, that the specific digital game helps the students’ memory and intellectual development, and furthermore it plays a significant role in the development of their mathematical thinking. From the questions of the questionnaire, as well as from the general question, the learning value of the game is highlighted, which will contribute positively to the whole educational process.

Through the use of the digital game the “Four Forces”, an effective learning environment is being created, as mathematical concepts are presented in a more specific and attractive way to the student, aiming at reducing pupils’ fears for Mathematics.

In this study, all the data are divided into six categories so as the validity of the results to be more understandable: These categories concern “Memory and Learning”, “Memory and Attention”, “Memory and Mathematics”, “Metacognition-Metamemory”, “Learning difficulties in

Mathematics” and “The Digital Game”. A general perception and an open question are also included.

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## Using Concept Maps to Teach Dyslexic Students Science: The Educators' Approach

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### *Abstract*

In this paper educators provide a valuable feedback in the use of concept maps in secondary education. More specifically their use in teaching dyslexic students Science. Almost 100 educators replied to an online questionnaire after they studied a set of evaluation sheets provided to them based on concept maps. We will begin with a brief presentation of the specific learning difficulty of dyslexia; following that are the main general characteristics and challenges that dyslexic students face. Also, the organization of Science classes for the dyslexic student is briefly discussed. Then information regarding concept maps is given. A presentation and quick discussion of four evaluation sheets with concept maps in the science subjects of Chemistry, Biology and Physics is performed. The main part of this paper presents the questionnaire along with a discussion regarding its results. Finally, conclusion are drawn and future work is mentioned.

*Keywords:* dyslexia, science classes, concept maps, questionnaire.

### 1. Introduction

The definition of the dyslexia given by the International Dyslexia Association is the following (*Definition ...*, 2017):

“Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge”.

Dyslexia is studied from different perspectives and different Sciences. Scientists from the areas of medicine, psychology and education have studied it producing theories that do not overlap in the majority of them.

- Participants are well aware of the challenges that apply to teaching dyslexic students.
- Most of the participants use quite often evaluation sheets and have a quite good knowledge of concept maps.
- Most of the participants answered that concept maps can be helpful in revision of a science class.
- Participants thought that concept maps improve memory, metacognitive skills of dyslexic students.
- Participants thought that concept maps facilitate learning of procedures from dyslexic students.

In the following sections of this paper the general characteristics and challenges that dyslexic students face are presented, followed by the organization of Science classes for the dyslexic student and a reference to concept maps. Then four evaluation sheets based on concept maps in science classes are briefly presented. The main part of this paper focuses on the questionnaire which was given to approximately 100 educators and its results. Finally, there exists a discussion of the results along with our conclusions.

### *1.1 General characteristics and challenges that dyslexic students face*

When demanding subjects like Science are being taught to students with specific learning difficulties, or more specifically dyslexia, educators must cope with an even more challenging situation.

Specifically, students with Specific Learning Difficulties (SLD) although they are quite bright (they rank in IQ tests above average) they have severe difficulties in reading, writing and spelling. They perform better in oral than written examinations, and may show signs of attention deficit hyperactivity disorder (ADHD). In mathematics, they face difficulties in calculations and often perform computations with their fingers. They find it difficult to learn sequential processes, forget symbols (+ or -) and make basic computations by heart.

Polichronopoulou (Πολυχρονοπούλου, 2017) presents in her work the most important signs of dyslexia in the Greek language according to observations from Greek educators:

- Inversion of letters - numbers (3 for ε);
- Mirror reading or writing (με for εμ);
- Replacement of words with others that have similar meaning;
- Changing, missing or adding letters in the same word;
- Unjustified and weird mistakes, illegible writing;
- Difficulty in copying from the board;
- Difficulty in memorizing forms, tables, dates and names in order;
- Difficulties in the orientation of time and place.

### *1.2 Organization of Science classes for the dyslexic student*

Some characteristics of the Science classes' organization for the dyslexic student appear, such as the following:

- Science subjects should be organized and adapted in a multisensory way, both the theory as well as the related problems;
- The goals of the subject should be stated;
- The required information must be presented in an organized manner;
- Theory could be taught through a fictional story, or a fairytale;
- Main points should be stressed out;
- Easy to grasp examples should be utilized;

- Information should be presented with more than one ways;
- Visual – spatial representations used when needed;
- 3D models wherever applicable should be presented;
- Simple exhibition experiments, with easy – to – find everyday life materials, should be carried out;
- Use of simulation software for certain experiments; and
- The main points of each lecture should be repeated in the end.

Zamfirov (2011) also presents an interesting approach towards teaching Science to students with special needs. He states that:

“A bigger part of the physical objects – such as: atom, atomic nucleus, electron, proton, neutron, stars, galaxies, nebulas, etc. cannot be observed directly not only in the nature but even when special equipment and laboratory conditions are provided. The overcoming of those obstacles is possible only in case that accessible and interesting performance of the teaching contents including many visual stimulus – schemes, diagrams, pictures, photographs and primarily models of objects and processes – computer programs that visualize different processes. All that is connected with development of students’ abstract thinking and finding ways to extract information from that visual stimulus”.

### 1.3 Concept maps

Concept maps are graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line linking two concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the two concepts. We define concept as a perceived regularity or pattern in events or objects, or records of events or objects, designated by a label. The label for most concepts is a word, although sometimes we use symbols such as + or %, and sometimes more than one word is used.

Concept maps were developed in 1972 in the course of Novak’s research program at Cornell University where he sought to follow and understand changes in children’s knowledge of science (Canas & Novak, 2017). They were mainly based on Ausubel’s work in the concept of meaningful learning, where the new knowledge to acquire is related to previous knowledge. So basically, learners are “integrating” new information to old information.

The basic categories of concept maps are hierarchy concept maps, spider concept maps, flowchart concept maps and system concept maps. They have been used in different educational fields; namely in Science, History, Language and Informatics.

Dyslexic students can benefit by using multisensory teaching methods which include concept maps in Science classes. Scientific terms and mathematical equations can be presented more clearly and efficiently with them (Pavey, Meehan & Davis, 2013). These students read quite slowly, get easily tired and discouraged. They also face difficulties in understanding information in writing, which causes quite a few difficulties for home study. But with the use of concept maps as revising tools they can greatly improve their school performance (Lami, 2008).

Below are some of the possible applications of concept maps in the educational process:

- Students making their own concept map;
- Corrections in a given concept map by doing the necessary adjustments in the concepts used and/or the relations between them;
- Adding new concepts in an already structured concept map;

- The completion of an unfinished concept map with concepts, relations among them, linking words or phrases between concepts;
- Any combination of the above.

The above can be done by students individually or in groups (Γούλη, Γόγολου & Γρηγοριάδου, 2006).

## 2. Concept maps used for teaching dyslexic students Science

In our research for innovative methods of teaching students with dyslexia Science we believe that our approach should include multi-sensory instructional methods. A lecture of Science adapted for dyslexic students should include the use of the student's senses, examples from everyday life, concept maps, graphs, tables. They would bring a holistic approach to learning and attract student's attention.

An early work by (Ferentinou, Papalexopoulos & Vavougiou, 2009), which presented force F in High School physics by using concept maps gave us strong motivation to study and apply further concept maps. In this part four evaluation sheets concerning the science subjects of Chemistry, Biology and Physics are presented and briefly discussed. They are given to students for 10 to 15 minutes. Students are divided in two groups, ideally of the same number where dyslexic students are in both groups. From their answers to the questions of each evaluation sheet an assessment of can be performed. The complete evaluation sheets are presented in the end of this paper.

### 2.1 Teaching dyslexic students Chemistry using concept maps

We concluded in the use of the physical states of matter in the subject of Chemistry, which is taught in the second grade of High School in the Greek educational system (Vlachos & Zamfirov, 2017). It should be noted that it is the first year that students are taught Chemistry. Two concept maps will be utilized; one with the physical states of matter and their characteristics regarding mass, volume and shape (Figure 1). The other (Figure 2) presents the three states of matter that the school book presents (there exists one more which is omitted; plasma state) and the transitions between them.

Students will be split in two groups; the one group will be taught with the conventional way and the other one through concept maps. Following that they will both answer a set of questions. The set of questions is presented later in this paper. All this procedure should be completed within 45 minutes.

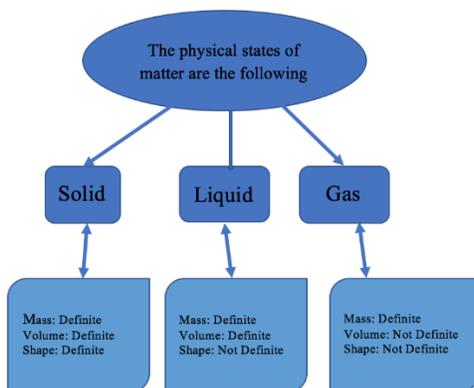


Figure 1. Concept map of physical states of matter

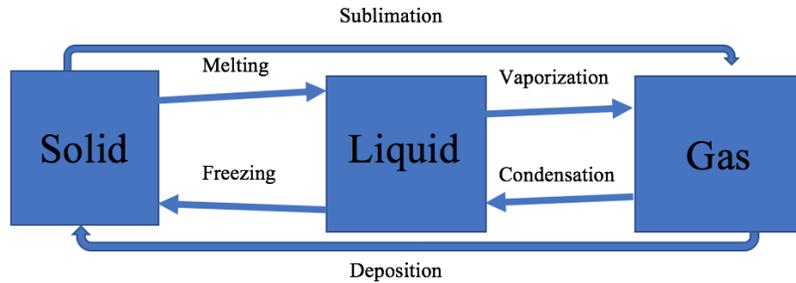


Figure 2. Concept map of transition of physical states

Questions:

1. Match the change of state with the name of the procedure:

Change of state	Procedures
a. From Solid to Liquid	1. Freezing
b. From Solid to Gas	2. Deposition
c. From Liquid to Gas	3. Condensation
d. From Gas to Liquid	4. Melting
e. From Liquid to Solid	5. Sublimation
f. From Gas to Solid	6. Vaporization

2. Fill in the gaps in the following phrases with words (definite, not definite):

- a. Solids have ..... volume and ..... shape.
- b. Liquids have ..... volume and ..... shape.
- c. Gases have ..... volume and shape.

Following the answer of the above questions from the students we will be able to study if our method provided any improvement in the understanding of the students and to what degree.

### 2.2 Teaching dyslexic students Biology using concept maps

In the science subject of Biology, we use concept maps in the human respiratory system which is taught in the 1<sup>st</sup> grade of high school (Βλάχος & Zamfirov, 2017). This is a quite complex and demanding class module and poses many difficulties even to the general student population. We split the students in two groups; the first in the end creates the concept map of the human respiratory system, while the second one will just perform a recapitulation of the module. Then an evaluation sheet is given to both teams.

The students have to create the concept map presented in figure 3. In order to create it we provide them with a small guidance – help. Depending on their level as well as their skills, the number and the names of the organs are provided. Or just their number.



Figure 3. Concept map of the human respiratory system of organs

By using concept maps in the end of a module we help dyslexic students in its review. In this specific module, we provide them with help and guidance to learn a difficult sequence, like the human respiratory system. It contains a large number of organs and quite difficult scientific terminology.

A concept map of the organs of the human respiratory system in which the students can add notes is presented in Figure 4. This concept map can help students in the revision of a module, but it can also be used for evaluation purposes.

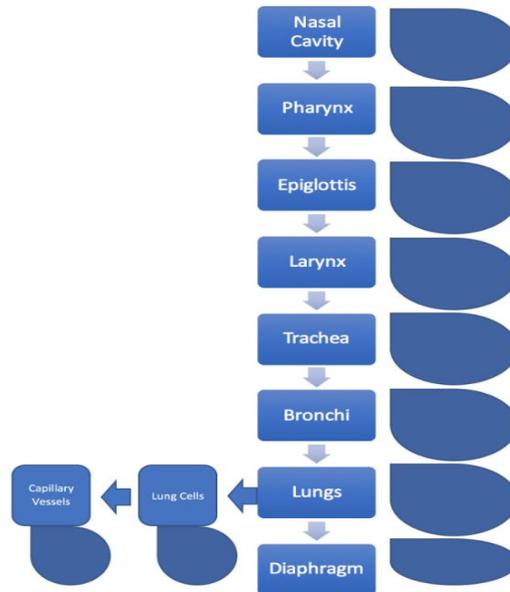


Figure 4. Concept map of the organs of the human respiratory system in which the students can add notes

### 2.3 Presentation of mathematical equations of Physics using concept maps (Ohm's Law, density)

In the science subject of Physics, we utilized concept maps for Ohm's law and the mathematical equation of density  $d$  (Βλάχος & Zamfirov, 2017). These two impose increased difficulties to all students; especially to dyslexic students. Ohm's law is very important since it is used not only in class exercises, but also in lab exercises during the 3<sup>rd</sup> grade of high school. On the other hand, the mathematical equation of density is used in lab exercises in the 1<sup>st</sup> grade of high school and in class exercises in the 2<sup>nd</sup> grade.

It should be noted that a discussion is being made with the students during a brief theoretical presentation about the role that material of the resistor plays in the calculation of the resistance (Ohm's law). Apart from stating that electrical resistance is different in every material; also, temperature and dimensions of the resistor (length, cross section area) also affect its resistance. Likewise, in the theoretical discussion concerning density, a presentation of the equation that calculates the density of a material ( $d = m/V$ , where  $m$  the mass and  $V$  the volume) is made. Subsequently, through examples and discussion it is presented that density is different in every material.

The computation of  $X$  of a mathematical equation ( $A \cdot X = B$ ) is taught in 2<sup>nd</sup> grade mathematics class and presents increased difficulty to all student population. Ohm's law and density are computed with equations ( $A \cdot X = B$ ). Science class teachers often have to present or to remind mathematical knowledge that is vital to their subject. Unfortunately, the curriculum of mathematics and science do not go hand in hand. So quite often students have to be reminded or even taught of necessary mathematical knowledge in science subjects.

With the concept maps presented in figures 5 and 6 below, the mathematical equations of Ohm's law and density  $d$  are solved for each variable. So, depending on the data the appropriate equation form is used. After a brief theoretical presentation of Ohm's law, the concept map is

presented. Then examples are taught where I (current intensity), V (voltage) and R (resistance) are computed.

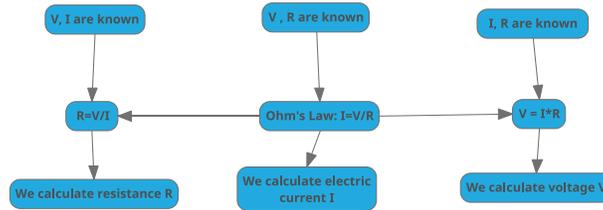


Figure 5. Concept map of Ohm's law

A similar procedure is being followed in the case of density (theory, concept map, examples, exercises to solve) where the mathematical equation of density is solved for the variables: d – density, m – mass and V – volume. Each of the concept map can also be used for revision purposes from students.

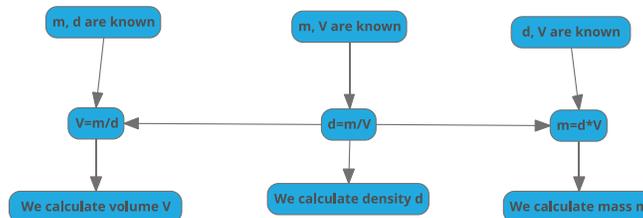


Figure 6. Concept map of the mathematical equation of density d

### 3. Questionnaire

We provided an electronic questionnaire to colleagues asking their opinion on concept maps in general and more specifically on the above presented ones. The questionnaire is presented in the end of this paper. It consists of 24 questions, which are all required to be answered in order for it to be submitted. Almost 100, 97 educators to be exact, participated in this research. The majority of the participants are working in Greek public schools in the secondary education. They are either substitute professors or permanent personnel and most of them are working in special education. Below are 24 diagrams, that present the results of our survey.

The questionnaire can be considered of containing three main parts. The first, where some general information about the educators are provided. The second, in which some general information regarding dyslexic students are obtained. And the third, which is the main part that asks for the educators' opinion about concept maps and our evaluation sheets.

### 4. Results and Discussion

As it can be seen in figure 7, the majority of the educators (58%) that participated in the survey are women. It is widely known that women dominate public education, both primary and secondary education. In figure 8, which presents the age of the participants, most of them are aged between 35 and 44 (46%). While more than  $\frac{3}{4}$  (76%) are 25 to 44 years old. This is a contradiction to the fact that teaching staff is aging fast in Greece; with the average age of professors in secondary education being 48 years old. This is partly answered later in question 5, but it should be noted that special education in Greece is manned mostly with substitute professors. They have an average age of 38 in Greece based on data from the Ministry of Education. So, in fact our data are very well aligned with the official ministry data.

In the next question, the results of which are presented in figure 9, the highest degree is required to be stated. The seminar in special education can be given, if the recipient has a postgraduate degree. Almost half (47%) of the participants to this survey hold a Master’s degree in Special Education or School Psychology, while 42% have university postgraduate degree or a seminar in special education. Half of them are highly qualified academically, but on the other hand many do not have any qualifications or hold only a seminar. This is due to the fact that many permanent educators work in special education without any qualifications. Also, some substitute personnel get hired only because of their extended work experience. The law gives the right to substitute professors to work in special education if their work experience is more than 10 months, without any academic qualification. PhD graduates exist in this research, but none of them holds a PhD in Special Education or School Psychology.

Regarding the school that they are currently working, question 4, as it can be seen in figure 10 more than half (57%) are working in general education which is mainly inclusion classes. Close to one in four are working in a special education school. In general, special schools in Greece are a minority. The high percentage is justified because participants are mainly working in special education. Next in figure 11, years of service of educators (question 5) proves the above mentioned. In Greece, it is almost a decade since the last educators become permanent public servants. Over 60% have a working experience of less than 10 years. This proves the fact that the majority are substitute teachers. This can also explain the low age average of the participants in question 2. Only 6% have more than 20 years of work experience.

The educators that answered the questionnaire are most of them women, aged around 35 years old. They hold a Master’s degree related to special education, work in Greek public general secondary education and have a working experience of less than 10 years. So, they are quite young of age, with high education. All the above mean that they can most certainly provide adequate schooling to children with special educational needs.

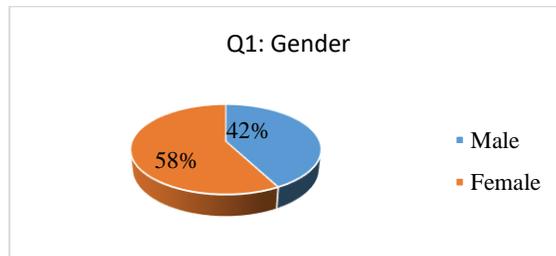


Figure 7. Gender of the participants

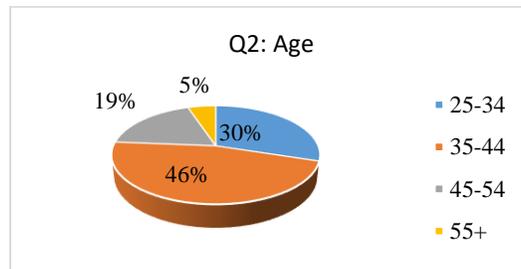


Figure 8. Age of the participants

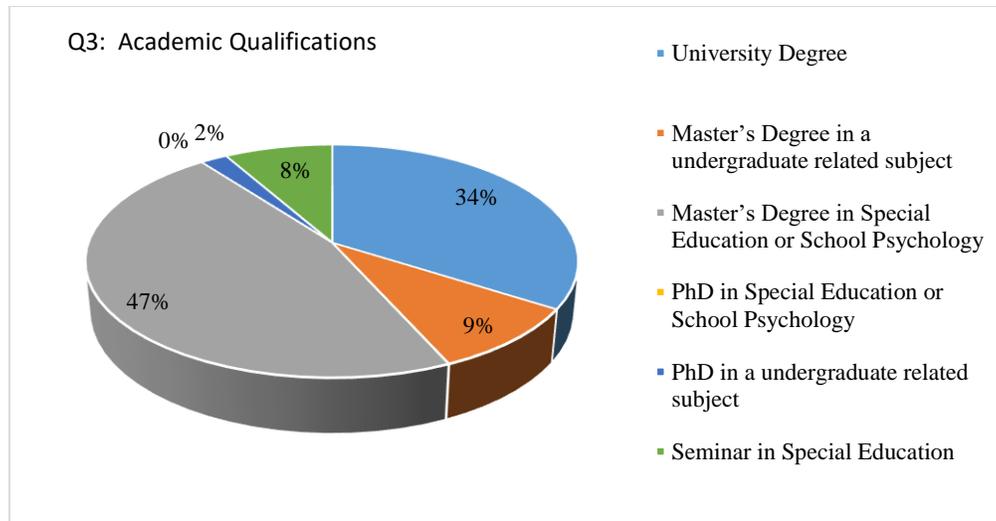


Figure 9. Academic qualification of the participants

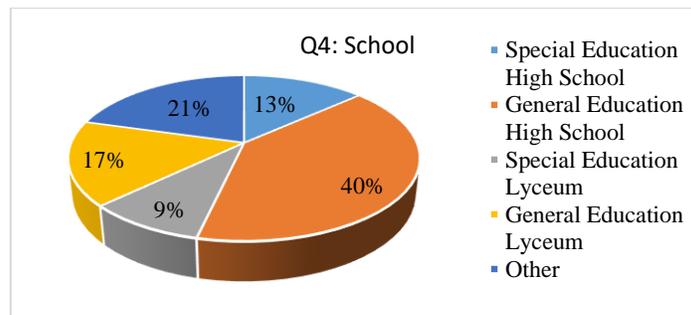


Figure 10. School that the participants are currently working

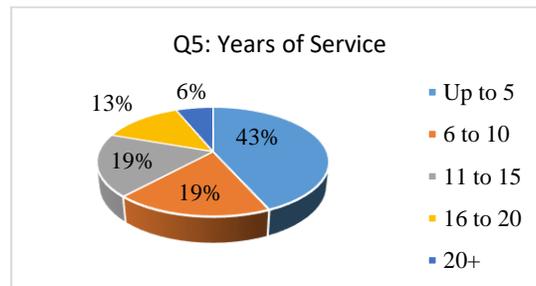


Figure 11. Years of service of the participants

Moving on to the second part of the questionnaire, questions 6 to 9 (Figures 12-15), where general knowledge of dyslexia and of dyslexic students is studied. Since the participants are employed in special education, it is no surprise that all, except one, are familiar with teaching dyslexic students. It can be assumed that the characteristics of dyslexic students are well aware by the educators. That is why, in question 7, no one from the educators answered that they face no difficulties when teaching dyslexic students. This category of student poses quite a few challenges in the teaching process. More specifically, 8 out of 10 stated that they face at least quite a few difficulties. Question 7 is also the first in a total of five questions in the questionnaire, where answers can be given in a scale from 1 to 4. In question 8, none of the educators in question provided a negative answer to the need for alteration of the instructions given to dyslexic students. Almost 6 out of 10 were certain that they should be modified, while the rest thought it was quite probable. In question 9, it is very comforting to see that 2 out of 3 educators when questioned

about the collaboration of school and the families of dyslexic students where quite satisfied. Only 3% was not happy with the school – family relationship.

Again, in questions 6 to 9 it is obvious that the participants are highly skilled and well aware of the characteristics and challenges that dyslexic students apply. It is more than obvious that in order to overcome the increased difficulties; a different approach of teaching should be implemented.



Figure 12. Collaboration with dyslexic students of the participants

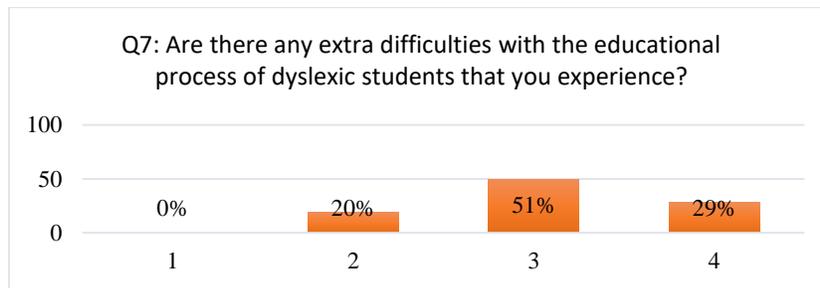


Figure 13. Difficulties faced by the participants with dyslexic students

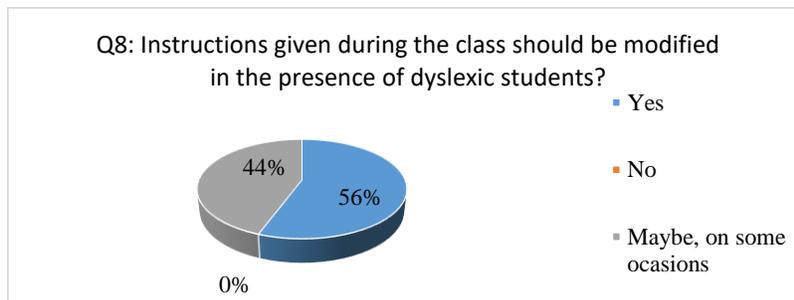


Figure 14. The opinion of the participants for the instructions given in class

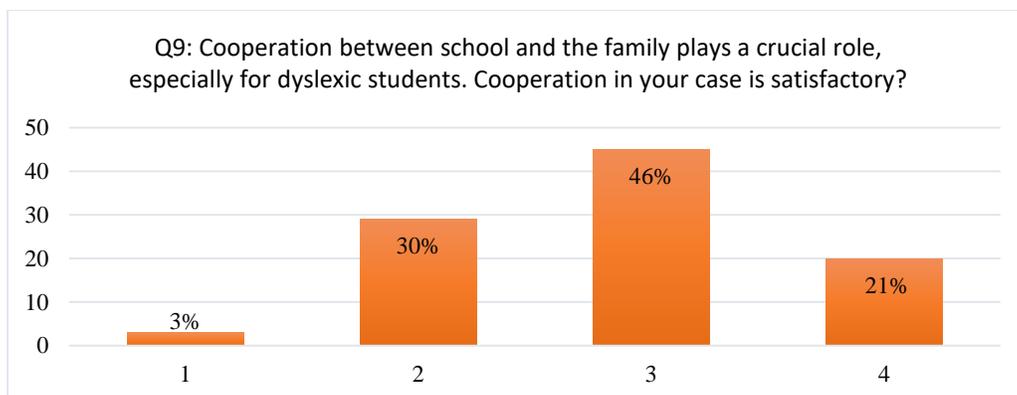


Figure 15. Cooperation of the participants with the families of dyslexic students

The last part of the questionnaire, figures 16 - 30, focuses on concept maps and their application in the four evaluation sheets provided to the participants. A brief discussion of the evaluation sheets was performed in the previous part of the paper; they can also be accessed in the end of the paper along with the questionnaire. In question 10 participants are asked if they use evaluation sheets in their classes. More than half (60%) replied that they use them quite often; while only 8 answered that they use them rarely. In the next question, question 11, almost 6 out of 10 stated that they know concept maps. Whereas, only 4 replied that they have no knowledge of them whatsoever. Also, the remaining 38% answered that they have some basic knowledge of them. Therefore, at least 60% use quite often evaluation sheets and have a quite good knowledge of what a concept map stands for. In question 12, they were asked to comment on the clarity of the evaluation sheets. Almost 6 out of 10 believe they are very easy to understand, while 89% believe that they are at least quite easy to understand. The above is very encouraging, especially when it comes from such a knowledgeable group of colleagues. Following that, in question 13, the participants give their feedback in the use of evaluation sheets of this kind and them improving understanding of science related classes. More than 6 out of 10 educators think that they are very helpful. On the other hand, none thought of it as not helping at all and only 7% consider it slightly helpful. The majority, 93%, consider them at least quite helpful.

Next two questions, namely 14 and 15, refer to revision and evaluation sheets of the proposed type as well as concept maps in general. In question 14, revision through evaluation sheets, only one participant gave a negative answer. While more than 3 out of 4 (78%), believe that evaluation sheets can be helpful as revision material. Revision of a class using concept maps is considered in question 15. Only 2 gave a negative answer, while an overwhelming 80% provided a positive answer. In both questions, almost 80% of the participants answered that concept maps or evaluation sheets based on them can be quite helpful in recapitulation and revision of a science related topic. Moreover, in question 16, 84% of the participants think that teaching using concept maps is more pleasant than any other conventional method of teaching.

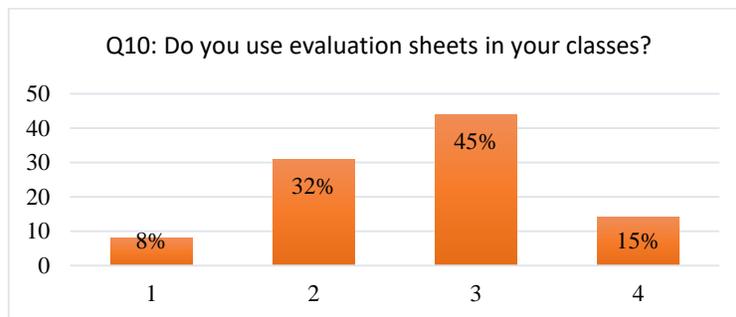


Figure 16. Use of evaluation sheets by the participants

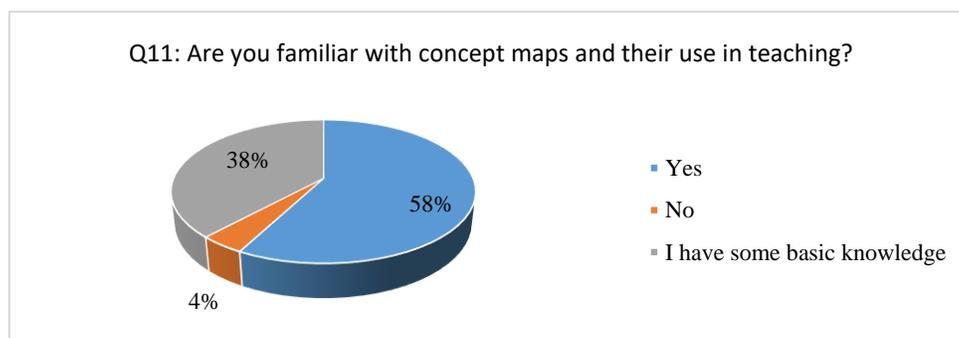


Figure 17. Knowledge of concept maps from the participants

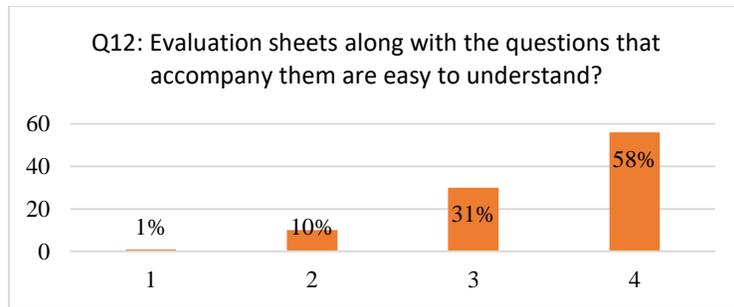


Figure 18. The participants' opinion about the evaluation sheets given to them

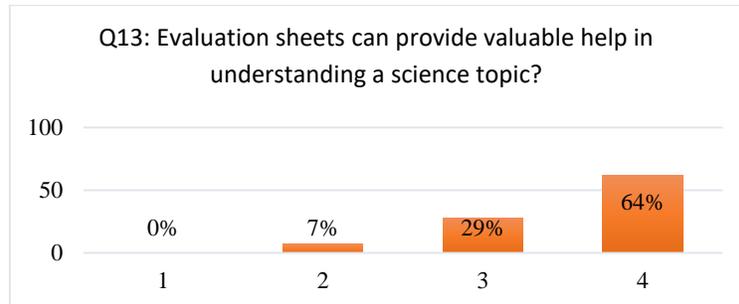


Figure 19. Participants reply on whether evaluation sheets improve understanding of science topics

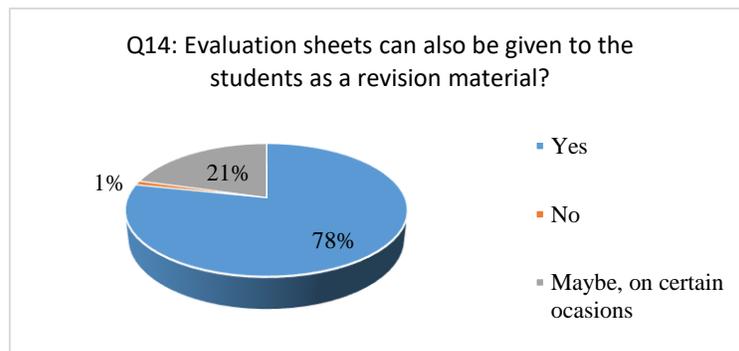


Figure 20. Participants reply on whether evaluation sheets can be given to students for revision

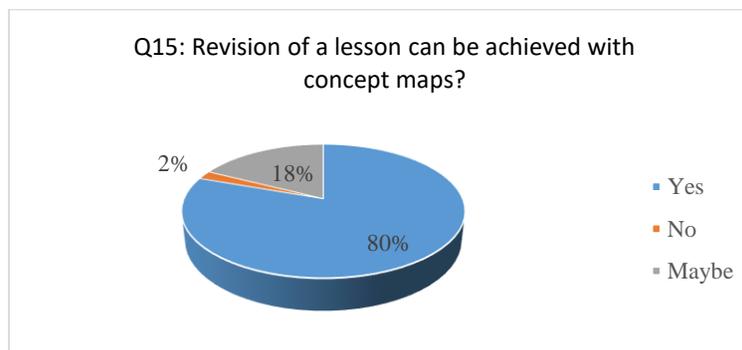


Figure 21. Participants reply if concept maps can be used for revision purposes

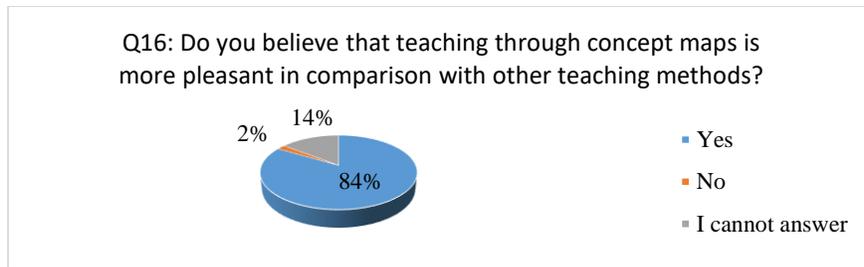


Figure 22. Comparison of teaching with concept maps to traditional methods

The following 6 questions (figures 23 - 28) are directly related to dyslexic students. In question 17, 85% of the participants to the survey gave a positive answer to whether evaluation sheets of this type can improve the understanding of dyslexic students on science topics. In the next one, which is question 18, evaluation sheets like the ones given to the participants are considered as a medium to improve memorization of mathematical equations and scientific terms for dyslexic students by almost 3 out of 4 of the participants. Likewise, in question 19 a vast percentage of 73% believes that using similar evaluation sheets can be a great help to dyslexic students at their home study. This can result in reducing reading to a minimum. Also, the great majority (70%) of educators which were asked agreed with the statement of question 20. They believe that procedures that are complex and include quite a few steps, like mathematical equations, can be learned more easily if they are presented - taught with concept maps. They also agree, partly or fully, with the statement of question 21. Metacognitive skills are thought to be developed by using concept maps by 80% of the participants. In question 22, only two educators thought that concept maps do not act as a technique that facilitates learning. While, 76% believed that it can enhance memory of dyslexic students. In the questions referring to dyslexic students specifically, participants thought that concept maps improve memory, metacognitive skills and facilitate learning of difficult and complex procedures.

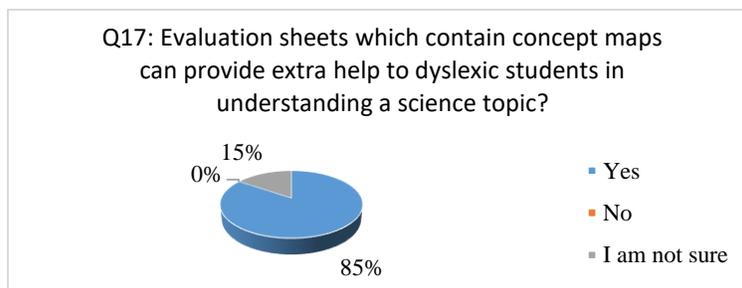


Figure 23. Participants reply on whether evaluation sheets of the type given can help dyslexic students to understand a science topic

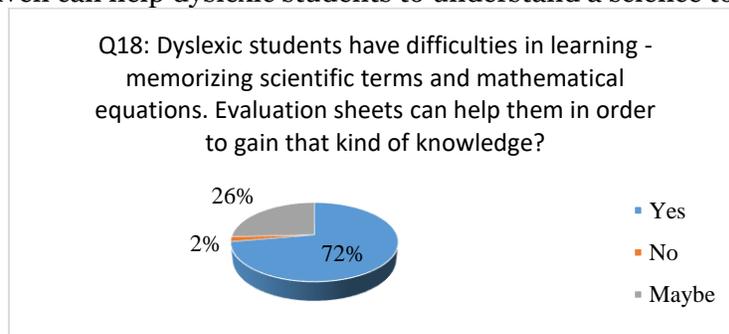


Figure 24. Participants reply to whether the given evaluation sheets can help dyslexic students in learning – memorizing scientific terms

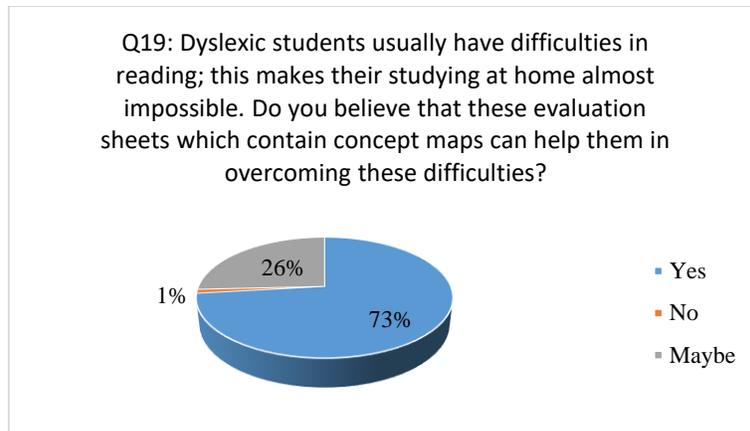


Figure 25. Participants reply on whether concept maps can improve home study

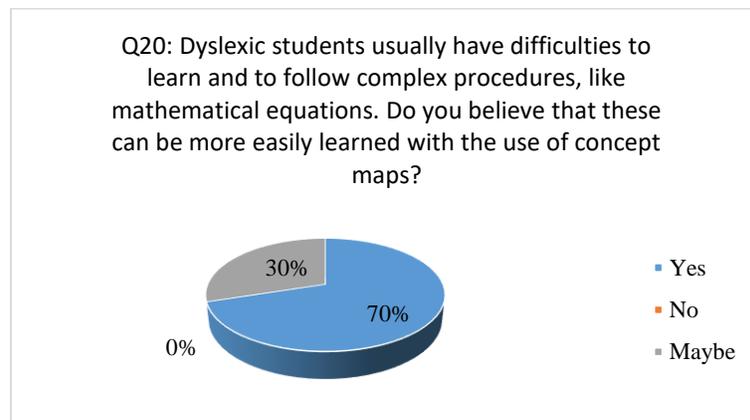


Figure 26. Participants reply to whether concepts maps can facilitate learning of complex procedures

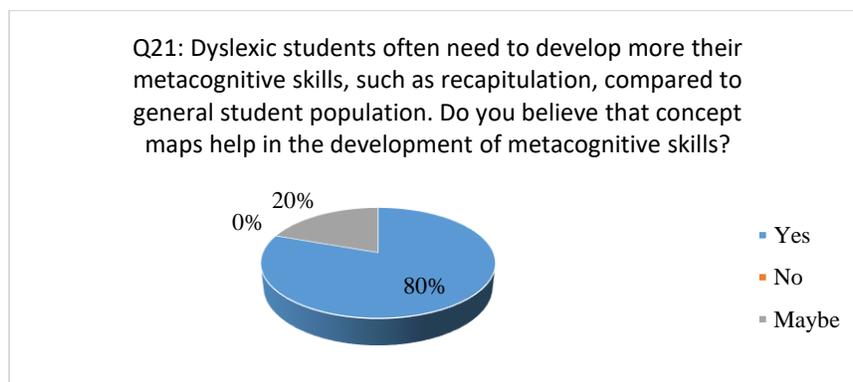


Figure 27. Participants reply to the possible improvement of metacognitive skills by using concept maps

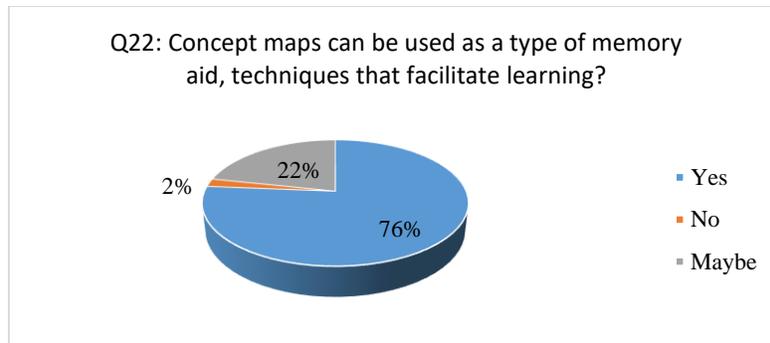


Figure 28. Participants reply on whether concept maps can be used as a type of memory aid

In question 23 (figure 29) the participants were asked to choose one or more group of students which in their opinion would gain the most by using concept maps. The top choices were general student population and students with dyslexia with a percentage of 79% and 76% respectively. Next are students with mild retardation (42%), followed by students with autism spectrum disorder (30%). Participants were also given the opportunity to choose the option “Other Group”, but were kindly asked to name that group. Four participants in total replied with this option, and gave us the following answers:

- Students with limited sight or hearing,
- Students with dysgraphia or other specific learning disabilities (SLD),
- Students with attention deficit hyperactivity disorder (ADHD),
- All students.

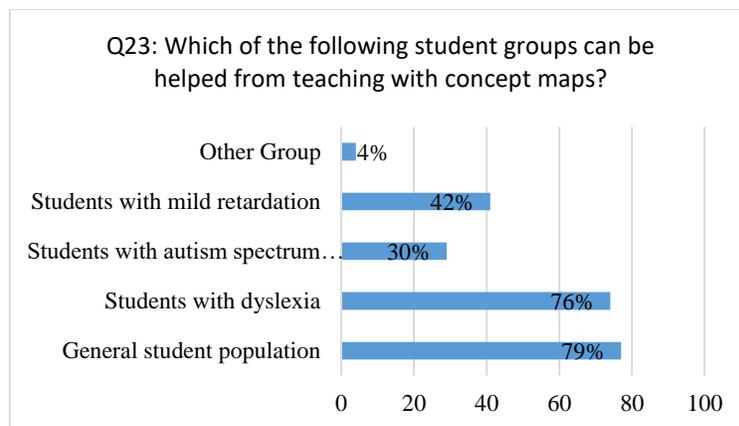


Figure 29. Group of students that could benefit from teaching with concept maps

In the last question (Question 24 – Figure 30) we asked the participants to help us optimize our effort. In total, 16 thought that they would be improved. In case their reply was “Yes”, we kindly asked them to give us their suggestions. Unfortunately, not all 16 participants that replied “Yes” gave us their valuable feedback. Two educators suggested the use of more questions, five of them thought that the use of images could prove quite useful, and three suggested the use of more evaluation sheets containing concept maps.

Regarding their remarks, the use of more questions on the evaluation sheets could prove time consuming. Our goal for them is to be completed in 10 to 15 minutes maximum. The use of images could improve evaluation sheets, although the main scope of our study is on using concept maps. Finally, we are currently working on more evaluation sheets in science classes.

Nevertheless, we did not want to provide participants excessive information that would require extra time. We believed this could discourage them from completing our questionnaire.

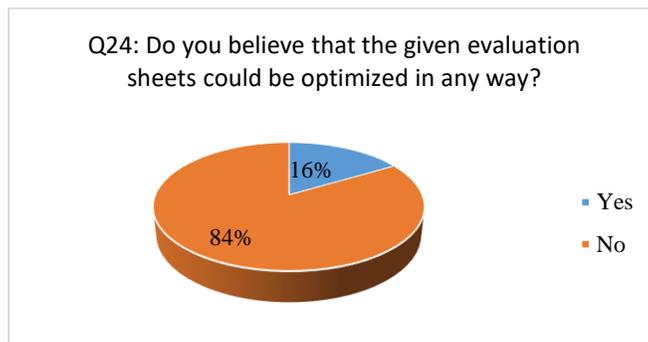


Figure 30. Participants reply on whether the evaluation sheets could be improved in any way

## 5. Conclusions

In this paper, we provided educators with four evaluation sheets and a questionnaire which are presented in the end of this paper. The participants that answered the questionnaire are quite young of age and with high education. So, they are quite established professionals that are highly skilled and well aware of the characteristics and challenges that apply to dyslexic students. More specifically, the majority of them use quite often evaluation sheets and have a quite good knowledge of concept maps.

Regarding our evaluation sheets, almost 60% believe they are very easy to understand, while 89% believe that they are at least quite easy to understand. Almost 80% of the participants answered that concept maps or evaluation sheets based on them can be quite helpful in recapitulation and revision of a science related topic. Moreover, 84% of the participants think that teaching that uses concept maps is more pleasant than any other conventional method.

In the questions referring to dyslexic students, participants thought that concept maps improve memory, metacognitive skills and facilitate learning of difficult and complex procedures.

The above is very encouraging, especially when it comes from such a knowledgeable group of colleagues. We firmly believe that concept maps can be a powerful tool to the science teacher to use them to general student population, as well as dyslexic student population.

Our future work includes the creation of even more evaluation sheets of the proposed kind and their application to students of the general population, but mainly to dyslexic students.

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## Conflicts of interest

None.

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